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REPORT OF STUDIES ON UNIFORMITY OF QUALITY OF SUGARS

I. Chemical Studies of Beet Sugars Collected During the 1939 Campaign.

By E. K. Ventre and S. Byall

Carbohydrate Research Division,
Bureau of Agricultural Chemistry and Engineering,
U. S. Department of Agriculture.

II. Report on Biological Studies of Sugars.

By H. H. Hall

Food Research Division,
Bureau of Agricultural Chemistry and Engineering,
U. S. Department of Agriculture.

June 1940

I. CHEMICAL STUDIES OF BEET SUGARS COLLECTED DURING THE 1939 CAMPAIGN.

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Samples of sugar composited during the 1939 campaign, together with data on methods of factory operation during this period, were submitted by 73 factories processing beets in 17 states. These samples were representative of the production of all the sugar beet growing areas of the United States and are of all but 10 of the factories operating during the 1939 campaign. Two factories which were active in 1938 did not operate during the 1939 campaign.

One factory submitted two samples and two sets of data, one for the spring campaign and one for the fall operating season. This factory operated during the entire fall campaign as a Steffen factory, and for two-thirds of the duration of the spring campaign it operated as a non-Steffen factory and for one-third as a Steffen factory. During the spring campaign, however, this factory worked a considerable quantity of molasses, so for both spring and fall campaigns it is reported as a Steffen factory. Listing this factory in the Steffen group gives a total of 39 Steffen and 35 non-Steffen factories. Since two of the sugar samples were specially made sugars, they have not been included in the averages. The factory operating data for the period during which the samples were composited are given in Table I. Additional operating data not previously presented in this report are given in Tables V and VI and are grouped for convenience

according to the operation as Steffen and non-Steffen factories.

The analytical data for the samples are given in Table II, but omitting the two samples of specially made sugars only 74 are included in the averages. The averages for sugars collected in the 1939 campaign and the averages for sugars analyzed after the previous campaigns are given at the bottom of Table II. On comparing these averages, it is seen that the average sulphate content of the sugars from the 1939 campaign is greater than that for the 1938 campaign but less than the average for the 1937 campaign. The average chloride content of the sugars of the 1939 campaign decreased in comparison with that of previous years. A slight decrease in the average sodium and potassium oxide content of the ash occurs in the sugars of 1939 campaign in comparison with these averages for the 1938 campaign. It is interesting to note that the decrease in the sum of the Sodium and potassium oxides is 2.1 p.p.m. and that there is an increase of 2.6 p.p.m. in the CaO content of the ash of the sugars of the 1939 campaign. This fact might be interpreted to indicate the replacement of some of the sodium and potassium of the ash by calcium. The average of the foaming tests shows an improvement for the sugars of the 1939 campaign over the average for those of the 1938 campaign.

The data from several factories which have supplied samples for 10 consecutive years are presented in Table III. The average purity of the white massecuite is practically the same for the past two campaigns. The average turbidity value, minus logt x 10^5, increased from 671 for the 1938 campaign to 766 for the 1939 campaign. The average ash content of the sugars from these factories has remained nearly constant for the past three campaigns. The average sulphate content of the sugars from this

group of factories showed an increase from 9 p.p.m. for the 1938 campaign to 12.6 p.p.m. for the 1939 campaign, but was not as high as the average for the 1937 campaign. The trends noted for ash, turbidity and sulphate content of the sugars from these several factories are in the same order as the averages for all factories during the past three campaigns.

Sugar Rating Formula

The sugar rating formula has been modified to include as a component the sulphite content of the sugars. The formula used for sugars of this campaign is: 100 minus the sum of the B-K color index plus the B-K turbidity index plus the percent ash x 10^3 plus the percent sulphites x 10^3 of the sugar equals the formula rating of the sugar. In this report, whenever comparison is made with formula ratings of sugars of previous years, such ratings have been recalculated on the basis of the above modified formula. It should be understood, however, that the inclusion of the sulphite content of the sugars as a component of the formula and the weighting assigned to it are arbitrary, tentative, and subject to further amendment.

Grain size of the Sugars

Referring to Table IV, it is seen that a higher percentage, 43.61% of the 1939 campaign sugars, is retained on the screen (No. 50) retaining the maximum amount. This compares with 40.54% on No. 50 screen for the 1938 campaign. A strict interpretation would be that the sugars from the 1939 campaign possessed a greater regularity of grain size than the sugars of the 1938 campaign. It appears, however, that for such a material as white sugar, and with the screen sizes used in this test, a fairer

practical estimation of regularity of grain size would be to include a consideration of the percentages of sugar retained on the screens immediately adjacent to the one retaining the maximum percentage of sugar. Thus, it is found that for sugars of the 1939 campaign the percentage of sugar on the screen retaining the maximum percentage plus the percentages of sugar retained on the two adjacent screens makes a total of 74.99 percent. By the same method, sugars of the 1938 campaign give a total of 78.00 percent. Using these figures it appears that a greater regularity of grain size is obtained in the 1938 sugars than in those of the 1939 campaign.

An average of 20.58 percent of the sugar of the 1939 campaign was retained on screens of sizes larger than that (No. 50) retaining the maximum, and 35.64% was of smaller grain size than that retained on screen No. 50. The sugars of the 1938 campaign, by the same method of calculation, show 28.59 percent retained on screens of sizes larger than screen No. 50, and 30.76 percent of a smaller grain size than that retained on this screen. A simple interpretation is that the predominant grain size is smaller in the sugars of the 1939 campaign than in sugars of the 1938 campaign.

Reflectance of the Sugars

The average reflectance value of the sugars of the 1939 campaign is 91.54, and of the 1938 sugars, it is 91.72. This is a difference of 0.18 in favor of the sugars of the 1938 campaign. Referring to the practical estimation of regularity of grain size (see discussion under Grain Size of the Sugars) and to the reflectance values of the sugars for the past three campaigns (Table VII) some correlation is indicated, as shown

below.

Campaign	Retained on Screen No. 40 percent	50 percent	60 percent	Practical estimation of regularity	Reflectance value of sugars
1937	25.59	43.57	9.39	78.55	92.27
1938	27.61	40.54	9.85	78.00	91.72
1939	19.65	43.61	11.73	74.99	91.54

Quality of the Beets

Beets worked in 1939 were of a slightly better quality than those of the 1938 campaign, based on a comparison of the average sugar content and the average coefficient of apparent purity. The average sugar content of the beets for 1938 was 16.09 percent, and for the 1939 campaign it was 16.39 percent. The average coefficient of apparent purity of the beets for 1938 was 84.51, and for the 1939 campaign it was 84.97.

The average amount of molasses worked percent on beets was 6.70% in the 1939 campaign (Table VI), 6.74% in 1938, and 6.75% in the 1937 campaign, but considerable variations occurred in the amounts of molasses worked by the individual factories. It is interesting to note the practical identity in average percent of molasses worked during these three campaigns.

Boiling Systems

In view of the fact that there is considerable variation in the definition of sugar boiling systems, as reported in the data sheets, no reference to boiling systems is made in this report, pending clarification of exactly what is meant by a "four boiling system", "three boiling system", "two boiling system", etc. With cooperation of the operating personnel of the industry, it is hoped that acceptable definitions can be presented in time

for the next report so as to permit more precise evaluation of the data with respect to the classification of the boiling systems now in use.

Non-Steffen Factories

Table V presents data on operating practices and the formula rating of the sugars for the non-Steffen factories. Some of the data on carbon, predefecation and filtration have not heretofore been presented. This table is interesting in that it does not show correlation of sugar quality with any single practice or combination of practices, although nearly all combinations of practices now in use are represented. The only single practice generally followed is the use of filter aid. However, the quantity used and the point of application in the manufacturing process varies considerably. Allowing for all the different conditions that exist, such as beet quality, equipment, etc., it seems reasonable to expect that some standard, or most efficient, practice should exist for a given section or a given set of conditions. In order to determine, if possible, just what such practice consists of it is planned in the next report, with the approval of the industry, to group the factories into sections in which as nearly as possible similar conditions exist, thus facilitating discussion of operating practices. For this campaign again the sugars of the non-Steffen factories have a higher formula rating than those of the Steffen factories. (See Plate I.)

Steffen Factories

Table VI presents data on operating practices and the formula rating of the sugars for the Steffen factories. Some of the data on operating practices have not been presented before. As is the case of the non-Steffen factories, there is a lack of definite correlation between operating practices and the formula rating of the sugars, the use of filter aid being the

only single practice generaly followed, but with a wider variation (for Steffen factories) in the amounts of filter aid used and also a lack of uniform practice as to the point of application.

The average formula rating for the sugars of the Steffen factories is 2.06 points below the average for all the sugars of the 1939 campaign and 4.35 points below that for the sugars of the non-Steffen factories. However, in this campaign, as in 1938, the highest rating sugar was from a Steffen factory. From this it seems that, though the average rating of sugars from Steffen factories was lower than the average for non-Steffen factories, it should be possible to remedy this situation somewhat.

Predefecation

The 11 non-Steffen factories reporting predefecation data have an average formula rating of 69.7, or 2.28 above the average for all the non-Steffen factories. The 9 Steffen factories reporting predefecation data have a 66.78 average formula rating of the sugars. This is 3.71 points above the average formula rating for all the Steffen factories. This may or may not be significant, as some factories in both groups made sugars below the average of the group, and the data for comparing the quality of the sugars from these factories operating without predefecation under the same conditions is not available.

Average Quality of the Sugars, 1939 Campaign

The average quality of the sugars from all the factories in the 1939 campaign, judged by their formula rating, is slightly lower than that of the sugars from the 1938 campaign, yet is somewhat higher than for the sugars of the 1937 campaign. Numerically, the formula rating of the sugars

was 65.13 for the 1939 campaign, 69.05 for 1938 and 59.24 for 1937. The lower average formula rating of the sugars of the 1939 campaign, as compared with those of the 1938 sugars, is accounted for by an increase in the B-K turbidity index from 11.4 in 1938 to 15.6 in 1939, and in the ash from 0.0109 percent in 1938 to 0.0110 percent in 1939, thus over-balancing the improvement in the B-K color index from 7.5 in 1938 to 7.2 in 1939, and in the sulphite content from 11.5 p.p.m. in 1938 to 9.59 p.p.m. in 1939. Plate I is a graphic presentation of the formula ratings of the individual sugar samples segregated into Steffen and non-Steffen groups and their respective averages. The averages for all the sugars for each of the past three campaigns are also given.

Resume

Based on the formula rating, the sugars of the 1939 campaign showed an average quality below that for the 1938 sugars, but better than that for the sugars of the 1937 campaign. The difference in quality of the sugars of the 1939 campaign, as compared with the 1938 sugars, was almost wholly due to increase in the turbidity index.

The quality of the beets worked, based on average sugar content and average apparent purity coefficient, was slightly better in 1939 than in 1938.

It is proposed, with the cooperation of the operating personnel of the industry, to draw up more exact definitions of the factory boiling systems now in use.

In this campaign the Steffen factories again produced sugars with a lower average formula rating than the non-Steffen factories; but, also again, this group contains the factory producing the highest rating sugar.

Operating data, as now presented, show little or no correlation between operating practices on the one hand and sugar quality on the other hand, but do show what appears to be a lack of uniformity in operating practices. It is suggested, with the approval and cooperation of the industry, that in future reports the factory data be separated into groups according to some acceptable scheme of classification which might lead to correlations and aid in establishing for each group the most efficient operating practices.

TABLE I. - FACTORY DATA FOR BEET SUGAR SAMPLES, 1939 CAMPAIGN

Carbohydrate Res.Div. Number	Beets		Diffusion		Molasses	Method of carbonation		Alkalinities and pH's					Lime salts first liquor	SO_2 added		Sulphur burned per ton beets	White Massecuite			High wash apparent purity	High green apparent purity	Remelt sugars		Centrifugal Wash Water			Filter aid used	Carbon used	Filtration data 1st liquor		Temperature sugar as sacked
	Sugar	Apparent Purity	juice apparent purity	CaO on beets	worked on beets	First	Second	First carbonation	Second carbonation	Thin Juice	Thick Juice	First Liquor		Thin Juice	Thick Juice		Brix	Apparent Purity	pH			apparent purity			Temperatures	Quarts per machine	Qts. per 100 lbs. sugar sacked			Brix	Temperature	
	Percent			Percent	Percent											Pounds						High	Low	°C.						°C.	°C.
3901	16.28	83.7	84.4	2.33	N.S.	Batch	Cont.	0.083	8.3	8.6	---	9.1	0.041	Yes	No	0.18	92.1	93.8	8.6	94.8	89.1	98.8	92.4	96.0	16.0	5.3	Yes	Yes	60.8	96	50
3902	16.73	86.56	87.29	2.5	N.S.	"	Batch	.072	.007	8.14	---	8.22	---	Yes	Yes	.45	89.94	91.62	8.0	92.05	86.47	97.03	94.13	80.0	12.0	---	Yes	No	55.0	95	69
3903	17.08	87.67	89.7	3.72	6.62	"	Cont.	.060	.013	8.0	8.2	8.2	.036	Yes	No	.37	91.0	93.10	7.6	91.1	87.4	98.10	94.3	92.0	19.0	6.5	Yes	Yes	59.4	92	37
3904	16.69	87.5	87.5	1.40	N.S.	"	"	.084	9.3	7.7	8.3	8.4	.015	Yes	No	.68	92.3	90.0	8.4	91.0	82.1	97.4	85.6	85.0	12.0	1.7	Yes	No	68.4	92	32
3905	16.09	84.8	85.5	6.51	9.26	Cont.	"	.078	9.4	9.1	---	8.8	.039	Yes	Yes	.40	90.4	93.3	8.7	92.0	87.3	97.2	89.8	95.0	14.0	5.9	Yes	Yes	68.6	97	56
3906	16.91	---	88.3	3.69	6.59	Cont.	Cont.	.080	9.0	7.6	8.4	8.5	.010	Yes	No	.49	92.3	92.3	8.4	90.7	85.5	96.2	87.6	93	16	5	Yes	No	71.8	95	33
3907	16.92	---	88.3	1.30	N.S.	Batch	"	.076	9.4	7.9	8.6	8.5	.020	Yes	--	.55	91.4	90.9	8.5	88.9	81.6	96.3	88.0	91	15	5	Yes	No	72.7	90	37
3908	16.93	---	88.1	1.34	N.S.	"	"	.082	9.4	7.8	8.6	8.5	.010	Yes	No	.57	91.7	90.5	8.5	89.1	82.7	97.0	89.1	94	15	5	Yes	No	72.0	90	38
3909	15.13	84.2	85.1	2.20	N.S.	"	Batch	.098	.040	---	.102	7.7	---	No	Yes	.31	92.7	89.3	7.7	86.4	78.0	94.4		93	18	3	Yes	No	58.7	95	57
3910	14.53	81.24	81.1	3.29	5.41	"	Cont.	.063	.021	8.42	8.21	8.18	.143	Yes	No	.257	91.37	89.15	7.48	89.64	82.69	96.05	93.44	72	17	5.5	Yes	Yes	56.34	90	57
3911	14.79	81.8	83.6	5.4	7.23	Batch	Batch	.061	.020	---	---	7.1	.211	No	Yes	.50	91.6	91.0	7.0	88.4	83.5	97.4	94.5	90	10	3.5	Yes	No	61.2	95	49
3912	14.96	82.93	85.43	4.0	5.52	"	"	.093	.026	8.6	8.5	8.4	.121	Yes	Yes	.38	91.5	92.1	8.3	90.0	84.2	98.6	98.1	85	14	4.66	Yes	Yes	59.8	99	48.5
3913	17.06	87.63	88.80	2.5	N.S.	"	Cont.	.074	.012	8.2	9.4	9.3	.020	Yes	No	.45	92.5	92.0	9.3	91.5	86.1	96.1	89.3	95	14.2	7.0	Yes	Yes	67.4	92	50
3914	17.14	84.70	86.80	3.04	N.S.	"	"	.087	.011	8.5	9.2	9.2	.033	Yes	No	.72	91.9	91.8	9.3	92.1	84.7	96.5	86.7	94	14.0	5.1	Yes	Yes	70.1	96	68
3915	16.38	82.90	85.5	5.37	9.33	Cont.	"	.089	8.7	8.3	8.1	8.0	.079	Yes	Yes	.13	90.4	92.0	7.8	90.2	86.2	97.6	95.6	91	16.0	---	Yes	Yes	65.4	92	47
3916	16.29	84.64	85.68	2.50	N.S.	Batch	Cont.	.069	.018	7.83	7.36	---	.047	Yes	No	.60	92.3	87.52	7.11	83.57	75.17	95.77		85	21	6	Yes	No	62.68	95	59
3917	15.01	80.4	82.9	2.25	N.S.	"	Batch	.096	.020	8.70	9.1	8.4	.052	No	Yes	.40	91.4	91.8	8.4	90.2	85.3	99.0	97.0	92	16	---	Yes	Yes	---	95	55
3918	18.18	85.0	85.2	2.96	3.05	Cent.	Cont.	.082	8.9	8.3	7.9	7.9	.064	Yes	No	.45	90.7	92.1	7.4	89.9	85.4	98.6	93.1	90	13	5.2	Yes	Yes	68.8	97	47
3919	16.35	82.1	82.5	3.97	8.35	"	"	.090	9.0	8.4	7.6	7.7	.081	Yes	No	.35	91.2	91.5	7.2	89.8	84.1	97.9	93.1	90	13	5.23	Yes	Yes	71.4	96	47
3920	17.31	83.0	83.5	4.90	8.43	"	"	11.3	9.0	8.6	8.9	8.7	.050	Yes	Yes	.59	92.1	91.3	8.5	92.5	84.9	98.4	95.8	90	13	3.7	Yes	No	69.6	95	48
3921	16.53	83.6	84.4	2.69	N.S.	Batch	Batch	.09	.012	8.3	7.7	7.4	.037	Yes	Yes	.34	91.9	88.8	7.0	84.6	77.5	97.5		90	18	4.5	Yes	No	64.2	95	50
3922	15.69	84.4	85.38	2.07	N.S.	"	Cent.	.11	.021	8.7	9.6	8.7	.027	Yes	Yes	.56	92.2	91.4	8.7	90.0	84.2	98.6	91.7	94	17	6.4	Yes	Yes	65.3	90	38
3923	16.80	86.0	87.0	3.81	5.75	Cont.	Cont.	.08	9.3	8.4	---	8.3	.028	Yes	No	.30	90.4	92.4	8.4	90.8	86.3	96.6	92.8	91	13	4.25	Yes	Yes	67.0	93	59
3924	17.24	87.8	88.9	2.59	N.S.	Batch	"	.085	9.2	8.5	9.4	8.1	.021	Yes	Yes	.82	91.8	93.0	8.0	91.6	86.5	97.2	92.2	87	15.7	4.6	Yes	No	71.8	99	46
3925	15.58	84.28	85.39	4.20	7.11	"	"	.069	.015	8.3	8.5	8.5	.038	Yes	No	.38	91.2	91.7	7.8	89.4	85.0	96.8	91.1	95	15	5.61	Yes	Yes	68.3	98	45
3926	16.31	87.4	87.4	3.33	5.91	Batch	Cent.	.081	8.9	8.3	9.5	8.7	.007	Yes	Yes	.50	90.6	90.7	8.7	88.2	83.9	95.7	84.7	93	18	5.3	Yes	No	72.1	90	46
3927	17.08	87.8	89.9	3.65	6.54	"	"	.067	.008	8.0	8.3	8.4	.039	Yes	No	.32	91.0	93.1	8.5	91.6	88.3	98.2	93.7	96	16	6.0	Yes	No	67.1	97	32
3928	17.08	86.2	89.5	2.01	N.S.	"	"	.074	8.7	8.0	9.5	9.4	.040	Yes	No	.34	91.8	92.7	9.4	91.8	85.8	96.9	91.2	95	12.9	5.2	Yes	Yes	69.3	93	52
3929	17.96	87.6	88.6	3.81	5.95	"	"	10.9	8.7	8.1	---	8.3	.049	Yes	Yes	.79	91.4	91.7	8.3	88.5	85.4	97.1	89.5	89	16.	7.4	Yes	No	63.1	91	60
3930	17.78	85.1	85.1	3.56	6.82	"	"	.076	9.2	9.1	8.9	8.9	.031	Yes	No	.16	92.3	94.2	8.9	94.9	87.2	98.9	95.3	92	17	5.0	Yes	Yes	71.6	65	40
3931	14.97	83.5	85.1	2.0	N.S.	Batch	Cont.	.092	.020	7.8	9.0	8.9	.032	No	Yes	.45	92.6	90.7	9.0	90.0	82.5	99.1	90.2	90	19	6.9	Yes	Yes	67.1	92	55
3932	17.95	85.7	85.6	5.38	10.93	Cent.	"	.067	.013	8.3	8.0	7.9	.042	Yes	No	.52	89.9	92.7	7.6	87.9	---	99.1	93.8	91	18	5.8	Yes	Yes	66.9	95	51
3933	15.82	86.7	87.2	5.15	7.61	Batch	"	.070	.018	7.7	8.1	8.1	---	Yes	No	.59	91.0	93.2	7.8	92.6	87.8	98.3	93.0	92	20	6.6	Yes	Yes	71.3	87	43
3934	16.72	87.1	87.6	4.04	6.15	Cont.	"	.080	9.1	8.5	---	8.2	.023	Yes	Yes	.47	91.6	91.8	8.4	89.5	85.5	96.4	93.8	90	16	6.1	Yes	Yes	72.3	84	53
3935	15.07	79.0	81.9	5.16	8.30	"	"	.079	8.4	8.2	9.5	8.4	.038	No	Yes	.30	91.4	89.4	8.4	87.1	81.9	97.5	95.9	92	18	8.0	Yes	Yes	66.6	86	54

TABLE I. - FACTORY DATA FOR BEET SUGAR SAMPLES, 1939 CAMPAIGN

Carbohydrate Res.Div. Number	Beets: Sugar	Beets: Apparent purity	Diffusion juice apparent purity	CaO on beets	Molasses worked on beets	Method of carbonation: First	Method of carbonation: Second	Alkalinities and pH's: First carbonation	Alkalinities and pH's: Second carbonation	Alkalinities and pH's: Thin Juice	Alkalinities and pH's: Thick Juice	Alkalinities and pH's: First Liquor	Lime salts first liquor	SO2 added: Thin juice	SO2 added: Thick juice	Sulphur burned per ton beets	White Massecuite: Brix	White Massecuite: Apparent purity	White Massecuite: pH	High wash apparent purity	High green apparent purity	Result sugars apparent purity: High	Result sugars apparent purity: Low	Centrifugal Wash Water: Temperature	Centrifugal Wash Water: Quarts per machine	Centrifugal Wash Water: Qts. per 100 lbs. sugar sacked	Filter aid used	Carbonised	Filtration date 1st liquor: Brix	Filtration date 1st liquor: Temperature	Temperature sugar as sacked
	Percent			Percent	Percent											Pounds								°C.							°C.
3936	15.85	81.51	81.7	2.03	N.S.	Batch	Batch	0.104	0.022	8.5	8.8	8.6	0.025	Yes	Yes	0.34	91.0	91.9	8.6	92.9	85.6	98.0	91.1	93	16	6.5	Yes	Yes	70.5	92	46
3937	15.10	82.3	86.0	2.50	N.S.	"	Cont.	.101	.026	8.7	8.7	8.6	.076	Yes	Yes	.26	92.2	90.3	8.0	86.5	80.9	98.8	98.1	85	14	4.0	Yes	Yes	57.5	92	42
3938	15.17	83.73	85.9	5.89	6.629	Cont.	"	.083	.019	8.8	8.7	8.0	.094	Yes	Yes	.58	91.6	92.7	7.5	92.4	85.7	98.1	97.1	88	15.4	---	Yes	Yes	61.9	98	48
3939	13.15	82.9	82.6	4.20	9.05	Batch	"	.076	.011	8.0	7.1	7.8	.112	Yes	Yes	.52	90.6	91.5	7.2	92.2	83.5	98.7	91.1	90	15	---	Yes	Yes	70.0	90	—
3940	16.79	86.2	87.0	3.27	5.70	Cont.	"	.078	.014	7.8	7.3	7.7	---	Yes	No	.49	90.3	90.1	7.3	89.1	84.9	94.6	90.5	90	17.2	5.0	Yes	Yes	63.3	90	40
3941	16.79	86.2	88.8	2.05	N.S.	Batch	Batch	.067	.014	7.7	7.5	7.5	---	Yes	No	.73	91.9	90.9	7.5	86.9	83.4	96.3	89.0	89	12	4.0	Yes	Yes	71.2	90	72
3942	18.03	87.3	88.4	1.77	---	"	Cont.	.076	8.7	8.3	9.5	8.9	.008	Yes	Yes	.29	91.8	94.1	9.0	92.1	88.4	98.3	87.9	90	14	4.0	Yes	Yes	68.6	93	49
3943	18.44	84.3	86.9	2.44	N.S.	Cont.	"	11.3	9.0	8.5	8.6	8.3	.037	Yes	No	.19	92.0	93.8	8.3	93.9	88.2	98.9	97.8	92	14	5.5	Yes	No	69.3	88	50
3944	16.37	84.0	85.1	3.18	5.92	"	"	.085	.016	8.3	8.7	8.7	.048	Yes	No	.20	90.8	92.6	8.5	89.8	84.6	99.2	97.9	93	16.7	5.6	Yes	Yes	67.0	96	51
3945	15.72	83.9	85.9	3.54	5.32	Batch	Batch	.097	.020	8.7	8.6	8.1	.067	Yes	Yes	.29	91.1	91.9	7.7	90.7	85.2	98.5	97.6	85	18	6.0	Yes	Yes	64.0	100	59
3946	15.51	84.4	84.8	4.13	4.48	Batch	Batch	.064	.030	---	---	8.4	.028	No	Yes	.23	91.2	90.3	7.9	87.1	80.1	93.7		88	17.8	6.2	Yes	No	63.4	92	75
3947	15.75	83.8	84.7	3.94	6.51	Cont.	Cont.	10.8	8.9	8.1	8.0	8.0	.062	Yes	No	.59	90.6	91.7	7.9	91.6	83.3	99.3	94.0	112	16	5.2	Yes	Yes	68.1	85	55
3948	17.7	88.8	90.6	2.11	N.S.	Batch	"	.066	.019	7.8	8.4	8.5	.009	Yes	No	.77	91.2	94.0	8.4	92.4	88.0	98.9	92.8	90	18	5.0	Yes	Yes	64.9	95	52
3949	16.4	83.5	83.9	3.88	6.19	Cont.	"	11.2	9.0	8.9	---	8.6	.057	Yes	No	.23	92.8	92.0	8.2	91.8	84.9	98.5	94.0	94	18	4.5	Yes	No	70.7	90	45
3950	16.16	---	86.7	1.75	N.S.	Batch	"	.074	8.9	7.7	8.6	8.6	.012	—	No	.78	91.3	90.5	8.7	89.5	82.2	94.0	89.2	87	16	4.6	Yes	No	69.9	88	47
3951	16.79	85.7	87.3	3.87	6.69	Cont.	Cont.	.066	.014	8.3	9.1	8.9	.041	Yes	No	.30	91.7	92.3	8.8	91.0	85.7	96.5	92.3	91	15	5.0	Yes	Yes	65.0	92	33
3952	16.30	84.6	87.3	1.54	N.S.	Batch	"	.068	.014	7.8	8.5	8.5	---	Yes	No	.50	92.0	90.5	8.5	90.3	83.5	95.7	90.0	95	11	5.0	Yes	Yes	67.5	95	45
3953	16.86	86.1	87.1	2.12	N.S.	Cont.	"	.082	.012	0.007	0.081	.066	.046	Yes	Yes	.45	92.2	91.5	9.2	89.5	84.7	96.6	90.8	90	14.2	8.2	Yes	Yes	62.0	85	55
3954	18.0	87.4	88.8	3.6	7.59	"	"	11.2	8.9	8.3	7.8	7.8	.100	Yes	No	.21	91.7	93.2	7.7	87.2		97.7	95.5	81	12.6	3.8	Yes	No	67.0	97	46
3955	15.9	86.0	87.9	2.45	N.S.	Batch	Batch	.103	.020	8.7	8.8	8.1	.047	Yes	Yes	.36	91.7	92.1	7.9	92.5	84.7	96.9	93.1	90	14	4.1	Yes	Yes	61.0	88	43
3956	14.7	82.5	84.5	4.69	7.83	Cont.	Cont.	.090	.021	8.6	8.6	8.4	.060	No	Yes	.31	90.7	91.7	8.2	89.6	84.1	98.6	94.3	93	16	4.8	Yes	Yes	59.5	90	56
3957	15.6	86.8	86.8	3.39	5.97	Batch	"	.063	9.0	7.9	8.7	8.7	.011	Yes	No	.64	90.2	91.1	8.6	88.6	85.1	96.1	90.3	85	14	3.5	Yes	No	71.4	85	51
3958	16.28	86.0	87.6	3.79	7.00	Cont.	"	.062	.013	8.1	7.9	7.8	.040	Yes	No	.37	91.7	91.7	7.7	89.6	86.0	98.1	91.6	91	16	8.0	Yes	Yes	70.8	87	50
3959	14.90	80.4	82.0	5.65	7.36	Batch	Batch	.056	8.8	8.8	8.7	8.1	.109	No	Yes	.11	90.3	90.6	7.7	90.0	82.7	98.6	98.0	93	14.2	4.8	Yes	Yes	66.0	92	48.5
3960	18.64	89.4	89.4	1.33	N.S.	"	Cont.	.076	9.4	7.7	8.5	8.4	.008	Yes	No	.61	91.2	91.8	8.4	89.2	85.9	98.1	86.7	90	16	4.9	Yes	No	70.7	87	50
3961	16.85	85.9	87.5	2.07	N.S.	Cont.	Cont.	.065	.015	7.8	8.2	8.1	---	Yes	No	.60	92.1	90.2	8.2	87.5	82.5	96.4	91.4	87	14	4.0	Yes	Yes	68.5	90	52
3962	16.01	---	85.8	3.44	6.43	"	"	.068	9.3	7.6	8.0	8.1	.015	Yes	No	.63	92.6	90.2	8.1	87.1	81.4	96.8	86.9	89	13	5.3	Yes	No	69.6	89	48
3963	17.68	87.9	88.8	3.57	5.95	"	"	.078	9.3	8.5	---	7.8	.013	Yes	Yes	.46	91.7	92.4	8.0	90.5	85.7	97.1	92.5	95	16	3.7	Yes	Yes	66.2	94	55
3964	12.73	82.3	82.3	2.18	N.S.	Batch	"	.087	9.2	8.2	7.4	7.7	.071	Yes	Yes	.78	90.7	93.1	7.3	92.9	86.5	99.3	92.8	90	21	4.3	Yes	Yes	70.9	85	46
3965	17.93	86.7	87.8	3.58	6.58	Cont.	Cont.	11.4	9.0	7.8	8.0	7.6	.127	Yes	No	.21	91.5	93.1	7.8	86.3		98.8	86.1	90	18	3.9	Yes	No	66.2	93.4	26.8
3966	18.79	87.6	87.7	2.7	N.S.	Cont.	Cont.	11.0	9.1	7.9	7.7	7.6	.033	Yes	No	.58	92.2	93.6	7.5	95.2	87.6	99.1	93.9	90	18	6.0	Yes	Yes	69.2	88	49
3967	14.21	82.5	85.0	2.38	N.S.	Batch	"	.088	.032	8.4	8.4	7.6	.029	Yes	Yes	.68	91.4	91.5	7.2	92.1	83.4	99.2	94.4	92	18	5.1	Yes	Yes	69.5	92	42
3968	16.00	---	85.4	2.72	4.66	Cont.	"	.073	9.4	7.6	8.2	8.4	.022	Yes	No	.64	91.8	91.0	8.3	89.9	83.0	96.9	86.8	92	15	5.9	Yes	Yes	67.7	90	37
3969	15.98	83.9	86.1	2.46	N.S.	Batch	"	.104	.020	8.8	8.9	8.4	.053	Yes	Yes	.25	91.3	91.0	7.8	89.3	83.3	97.6	94.2	82	13.1	4.4	Yes	Yes	65.8	92	48
3970	16.31	85.4	87.1	2.04	N.S.	"	"	.075	.015	8.1	8.8	8.8	.030	Yes	No	.44	91.7	90.9	8.7	91.3	83.9	97.5	88.7	95	14	5.9	Yes	Yes	67.7	94	62
3971	16.28	87.3	88.8	3.77	5.01	Cont.	Cont.	.069	.017	8.0	7.6	7.5	.072	Yes	No	.52	91.9	94.0	7.4	93.2	88.7	98.6	94.9	94	18	4.2	Yes	Yes	67.7	88	54
3972	18.20	84.6	86.8	2.95	N.S.	"	"	.085	.018	8.0	9.3	9.2	.035	Yes	No	.43	91.1	91.5	9.1	88.9	85.2	96.6	89.8	94	15	5.0	Yes	Yes	68.7	94	59
3973	17.20	86.3	86.3	2.21	N.S.	"	"	.079	9.1	8.0	8.8	8.4	.022	No	Yes	.62	91.0	92.1	8.4	90.0	85.7	95.1	91.5	91	16	5.2	Yes	Yes	71.4	98	52
3974	16.62	86.9	88.6	2.65	N.S.	"	"	.076	.018	8.5	8.4	8.4	.047	Yes	No	.25	92.5	93.9	8.4	92.2	87.4	98.4	91.3	96	15.8	6.4	Yes	Yes	70.0	92	51

vrt 5/22/40

TABLE II -- ANALYTICAL DATA ON BEET SUGAR SAMPLES, 1939 CAMPAIGN

Carbo-hydrate Div.No.	Foaming	Color B-K	pH	Turbidity		Ash	SO_3	Total SO_2	Cl	CaO	Na_2O	K_2O	Barley Candy			
					B-K								Color B-K	pH	Invert Sugar	Sucrose
	cc.	index		-log t	index	Percent	p/m	p/m	p/m	p/m	p/m	p/m	index		Percent	Percent
3901	90-80	6.0	6.9	0.00578	11.3	0.0056	1	3	7	8	10	4	9.8	4.7	1.62	96.59
3902	95-95	15.0	7.0	0.02078	35.0	0.0120	11	14	3	16	4	33	16.0	4.7	1.55	96.44
3903	85-80	4.6	6.9	0.00705	13.6	0.0108	7	11	4	11	5	39	12.0	4.8	1.40	96.74
3904	85-80	3.3	7.0	0.00413	8.2	0.0084	6	19	9	13	10	17	9.3	4.8	1.31	96.89
3905	100-90	8.4	7.0	0.00993	18.6	0.0199	67	7	11	27	17	53	11.5	4.7	1.54	96.89
3906	95-90	1.5	7.0	0.00618	12.0	0.0095	3	15	6	13	9	30	11.1	4.8	1.69	97.04
3907	115-90	1.9	6.9	0.00461	9.1	0.0062	9	12	6	11	5	14	7.2	4.8	1.49	96.74
3908	120-95	3.7	7.0	0.00455	9.0	0.0089	10	17	5	8	9	24	10.6	4.9	1.56	96.44
3909	95-85	6.1	7.0	0.00672	13.0	0.0108	12	15	3	10	6	25	13.2	4.8	1.75	96.74
3910	100-95	12.3	6.9	0.01125	20.8	0.0079	10	4	1	14	1	Trace	12.1	4.8	1.56	97.65
3911	95-85	13.9	7.0	0.00841	16.0	0.0172	4	3	1	20	8	65	21.5	4.9	1.52	96.29
3912	90-85	11.8	6.9	0.01155	27.5	0.0076	-	2	1	16	3	8	21.2	4.8	1.89	96.29
3913	85-80	12.9	7.0	0.00887	16.8	0.0105	8	3	3	10	2	27	11.0	4.8	1.78	96.59
3914	90-80	3.1	7.1	0.00487	9.6	0.0088	9	5	1	8	5	4	9.6	4.8	1.75	96.89
3915	100-85	12.6	7.0	0.01180	21.7	0.0108	-	2	1	13	9	7	17.7	4.7	1.50	96.59
3916	135-120	8.2	6.9	0.01382	24.9	0.0127	5	22	4	12	5	31	14.8	4.8	1.36	97.35
3917	90-80	5.4	7.1	0.00497	9.8	0.0093	1	4	2	9	3	18	13.2	4.7	1.59	96.59
3918	105-85	7.0	7.0	0.00508	10.0	0.0059	1	5	6	8	4	-	7.5	4.8	1.47	96.74
3919	115-85	6.6	7.0	0.00589	11.5	0.0077	2	2	11	10	10	-	9.2	4.7	1.55	96.59
3920	90-80	4.5	7.0	0.00508	10.0	0.0126	9	7	14	9	23	25	12.2	4.7	1.38	97.50
3921	105-100	9.2	7.1	0.00940	17.7	0.0173	10	4	4	14	7	72	19.8	4.8	1.37	97.07
3922	90-80	4.1	6.9	0.00699	13.5	0.0107	10	8	12	8	10	17	12.3	4.8	1.52	96.74
3923	100-85	7.8	7.0	0.00870	16.5	0.0116	9	5	7	8	8	31	10.5	4.7	1.19	96.59
3924	95-80	1.0	6.9	0.00371	7.5	0.0117	10	31	6	7	3	35	9.6	4.8	1.56	97.19
3925	105-85	4.9	7.1	0.00573	11.2	0.0146	11	3	18	7	13	45	11.7	4.7	1.23	97.35
3926	125-85	5.3	7.0	0.00683	13.2	0.0118	13	10	5	7	5	35	11.8	4.7	1.43	95.98
3927	90-80	9.4	7.0	0.01011	18.9	0.0121	13	9	4	10	3	32	12.3	4.6	2.29	95.07
3928	95-80	6.4	6.9	0.00628	12.2	0.0111	13	2	2	7	1	29	12.5	4.7	1.98	96.74
3929	100-85	4.4	7.0	0.00619	12.0	0.0147	19	18	4	7	10	52	13.4	4.8	1.34	96.44
3930	95-80	3.9	7.0	0.00350	7.0	0.0059	5	4	6	7	6	-	7.4	4.7	1.56	96.59
3931	95-85	8.1	7.1	0.01673	29.3	0.0130	14	6	21	5	7	31	12.7	4.7	1.57	96.13
3932	85-80	9.6	6.9	0.00546	10.7	0.0074	9	7	6	9	3	-	9.2	4.8	1.52	95.23
3933	95-85	8.4	7.0	0.01071	19.9	0.0200	28	22	33	6	20	55	12.8	4.6	1.54	97.04
3934	100-90	9.7	7.0	0.01382	28.5	0.0130	18	15	11	7	4	28	11.1	4.7	1.62	96.29
3935	90-85	8.3	7.0	0.00589	11.5	0.0233	13	4	33	11	21	75	14.6	4.8	1.27	96.74
3936	95-85	2.5	7.0	0.00335	6.7	0.0090	9	6	2	6	-	28	7.6	4.7	1.48	95.83
3937	95-85	11.8	7.1	0.00987	18.5	0.0072	6	3	1	12	-	12	11.8	4.7	1.63	96.29
3938	100-85	14.2	7.0	0.01017	19.0	0.0078	8	2	4	13	7	-	12.3	4.7	1.96	96.59
3939	90-75	4.9	6.9	0.00716	13.8	0.0067	2	4	2	9	4	2	10.1	4.8	2.20	94.77
3940	100-80	21.5*	7.0	0.02237	37.1	0.0100	3	14	7	9	4	14	11.9	4.8	2.32	95.23
3941	85-80	6.7	7.0	0.01046	19.5	0.0200	11	48	34	8	6	85	16.5	4.7	1.77	96.74
3942	100-85	1.3	7.0	0.00360	7.2	0.0087	5	7	7	8	3	15	10.2	4.7	1.64	96.59
3943	100-80	5.7	6.9	0.00750	14.4	0.0052	1	3	6	11	4	-	7.0	4.8	1.80	97.04
3944	90-80	5.9	7.1	0.00733	14.1	0.0098	2	3	1	12	1	27	13.3	4.8	1.57	96.29
3945	95-85	7.1	7.0	0.00546	10.7	0.0085	-	5	1	11	7	14	13.9	4.7	1.83	94.77
3946	110-95	6.8	6.9	0.00722	13.9	0.0140	3	8	10	11	10	43	17.3	4.8	1.47	97.04
3947	90-80	14.8	7.0	0.01492	26.6	0.0130	4	11	13	10	11	31	16.3	4.9	1.85	96.44
3948	95-85	2.0	7.0	0.00762	14.6	0.0132	4	29	1	6	3	50	13.6	4.8	1.82	96.44
3949	90-80	7.4	7.1	0.01077	20.0	0.0085	2	2	9	11	12	-	10.0	4.9	2.28	95.83
3950	115-95	2.3	7.0	0.00402	8.0	0.0082	6	14	5	11	2	20	7.2	5.0	2.23	96.29

TABLE II -- ANALYTICAL DATA ON BEET SUGAR SAMPLES, 1939 CAMPAIGN (CONTINUED)

Carbohydrate Div.No.	Foaming	Color B-K	pH	Turbidity	Turbidity B-K	Ash	SO_3	Total SO_2	Cl	CaO	Na_2O	K_2O	Barley Candy Color B-K	Barley Candy pH	Barley Candy Invert Sugar	Barley Candy Sucrose
	oc.	index		-log t	index	percent	p/m	p/m	p/m	p/m	p/m	p/m	index		percent	percent
3951	110-95	7.5	7.1	0.00816	15.5	0.0104	10	2	13	16	8	27	10.8	4.8	1.58	95.83
3952	95-80	4.1	6.9	0.00853	16.2	0.0148	14	19	25	13	7	44	13.5	4.7	1.66	96.29
3953	100-95	15.6	7.0	0.01896	32.5	0.0129	14	4	15	17	11	25	12.4	4.8	1.56	97.04
3954	120-100	7.7	6.9	0.00617	12.0	0.0068	6	2	3	14	6	7	9.9	4.8	1.52	96.44
3955	90-80	7.2	7.1	0.00934	17.6	0.0105	9	3	2	19	5	25	12.8	4.7	1.61	96.29
3956	85-80	11.0	7.1	0.00600	11.7	0.0138	7	4	1	12	16	32	15.6	4.7	1.60	96.44
3957	145-100	3.5	7.0	0.00508	10.0	0.0148	19	9	4	9	7	56	13.0	4.8	1.37	97.04
3958	90-80	19.6*	7.1	0.01896	32.5	0.0124	9	10	Trace	10	5	42	17.6	4.7	1.80	95.83
3959	100-90	12.3	7.0	0.01267	23.1	0.0111	8	2	Trace	15	5	28	15.6	4.7	1.87	96.44
3960	95-80	1.5	7.0	0.00324	6.5	0.0103	14	16	4	9	9	30	11.5	4.8	1.88	95.98
3961	90-80	6.5	7.0	0.01230	22.5	0.0139	16	21	17	14	10	32	12.7	4.8	1.38	95.68
3962	100-95	1.8	7.0	0.00503	9.9	0.0130	19	14	17	8	5	17	9.4	4.6	1.75	96.13
3963	120-100	6.3	7.0	0.01053	19.6	0.0142	15	14	12	7	11	43	14.3	4.8	1.73	96.74
3964	90-80	8.0	7.0	0.00824	15.7	0.0076	7	9	1	10	8	--	10.1	4.9	1.69	96.44
3965	95-85	8.1	6.9	0.00482	9.5	0.0069	6	Trace	3	11	6	—	8.5	4.9	1.43	96.74
3966	90-75	7.2	6.9	0.00928	17.5	0.0068	5	16	7	7	5	—	9.9	4.8	1.59	96.59
3967	85-80	4.7	7.0	0.00688	13.3	0.0161	10	27	3	10	12	45	15.8	4.7	1.25	96.89
3968	105-90	2.2	6.9	0.00304	6.1	0.0121	11	13	13	6	6	30	8.8	4.8	1.78	96.13
3969	85-80	5.6	7.1	0.00487	9.6	0.0092	7	4	2	10	5	12	13.8	4.8	1.63	96.44
3970	115-90	6.3	7.0	0.00957	18.0	0.0113	12	2	18	8	7	27	10.1	4.7	1.86	96.89
3971	90-85	9.0	7.0	0.01053	19.4	0.0111	7	15	2	8	9	15	12.3	4.8	1.50	96.13
3972	110-90	6.2	7.0	0.00476	9.4	0.0103	12	5	2	6	6	38	10.2	4.8	1.52	95.83
3973	110-90	4.1	7.0	0.00801	15.3	0.0119	13	18	6	8	5	39	12.4	4.9	1.78	96.74
3974	90-80	3.4	7.0	0.00535	10.5	0.0054	5	2	2	6	1	5	9.0	4.8	2.29	96.59
3975**	95-85	1.4	7.2	0.00445	8.8	0.0105	5	1	Trace	6	26	5	10.4	4.7	1.42	97.19
3976**	90-80	9.0	--	0.03345	50.0	0.0040	—	None	None	6	—	--	2.7	—	5.05	91.59
Averages																
1939-40	98.5-85.7	7.2	7.0	0.00829	15.6	0.0110	9.3	9.59	7.4	10.4	7.0	25.9	12.1	4.7	1.65	96.46
1938-39	101-82	7.5	7.0	0.00655	11.4	0.0109	7.8	11.5	9.5	7.8	7.3	27.7	14.5	4.76	1.64	96.73
1937-38	98-83	8.16	6.9	0.01128	19.76	0.0116	15.1	12.4	11.8	8.4	11.0	32.3	13.5	4.7	1.75	96.24
1936-37	92-71	9.4	6.8	0.01159	20.5	0.0135	14.1	12.4	6.2	8.5	13.3	43.2	13.9	5.0	1.18	96.95
1935-36	83-72	10.3	6.8	0.01482	24.6	0.0132	6.3	13.7	6.6	8.5	11.0	49.3	--	5.0	1.19	96.46
1934-35	84-73	--	6.8	0.01949	—	0.0140	15.6	16.5	5.8	8.4	9.6	41.3	—	4.9	1.07	96.36
1933-34	88-72	—	6.8	0.01938	--	0.0197	21.7	25.4	14.0	12.3	10.8	64.9	—	4.8	1.53	96.67
1932-33	90-72	—	6.8	0.01863	—	0.0245	22.4	26.6	13.0	16.0	25.5	102.6	--	4.7	1.42	96.09
1931-32	96-65	—	6.9	0.02245	—	0.0274	49.9	25.1	16.6	16.5	—	—	—	4.7	1.20	96.27
1930-31	90-65	—	6.9	0.03191	—	0.0389	95.5	23.2	—	—	—	—	—	4.7	1.43	95.91
1929-30	125-68	—	6.9	0.06 +	—	0.0427	—	—	—	--	—	—	--	4.5	1.60	--

* Milky solution

** 3975-76 Special sugars not included in averages

rrt 5/6/40

TABLE III - COMPARATIVE DATA FOR 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938 and 1939.

Factory	Apparent Purity of White Massecuite										Turbidity, -log t x 10^5										Ash, % x 10^3										Sulfates p/m									
	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939	1930	1931	1932	1933	1934	1935	1936	1937	1938	1939
A	82.0	84.4	83.7	85.0	90.2	90.0	90.6	90.7	90.6	91.7	1706	3343	1525	1008	3230	1176	807	2041	1243	1492	193	34	60	24	18	15	15	11	13	13	873	54	149	43	8	0	22	17	22	4
B	81.5	83.1	84.9	85.0	90.4	92.6	91.9	92.2	93.1	93.2	5943	4067	2479	603	1798	925	946	688	471	1071	254	61	32	30	17	19	23	19	16	20	1188	160	36	29	13	18	27	19	17	28
C	84.1	83.6	86.3	86.3	88.1	90.1	90.0	89.5	90.1	90.2	2686	2378	373	3230	525	763	482	648	319	503	89	58	25	20	15	11	15	10	11	13	360	235	22	43	18	3	19	19	2	19
D	83.0	84.9	85.7	86.9	88.5	90.3	90.4	90.6	90.6	91.1	3819	1522	2179	1615	1091	448	2313	1707	3472	508	95	42	36	26	21	16	19	17	14	14.8	357	85	39	23	17	1	41	20	13	19
E	85.5	87.4	87.8	87.6	88.3	90.4	90.4	90.8	91.0	90.7	2791	2476	1892	1892	1348	1436	720	975	492	683	98	32	25	35	30	12	14	12	12	11.8	309	27	3	23	21	0	10	21	7	13
F	87.0	86.6	87.5	88.1	91.1	92.4	92.3	92.1	92.70	91.8	2179	4733	3118	3007	3943	843	887	789	605	1382	124	50	81	22	39	13	12	10	12	13.0	471	149	307	38	246	0	12	16	3	18
G	84.7	86.2	86.0	85.5	89.0	91.6	91.4	93.1	93.60	93.3	3344	2896	2278	1615	2376	1008	744	578	397	993	40	47	26	36	32	15	17	12	13	19.9	105	191	26	127	129	2	20	21	10	67
H	89.8	90.2	90.4	90.0	90.9	91.9	92.4	93.6	94.20	94.0	1615	1173	146	763	1262	1892	782	882	964	762	17	19	14	15	14	11	12	12	12	13.2	2	11	0	3	0	0	22	17	3	4
J	----	83.6	86.0	89.6	91.2	91.2	90.8	91.9	92.40	92.7	1752	1522	146	925	1176	1091	1473	650	298	546	14	24	15	13	8	9	9	9	11	7.4	0	10	1	3	0	3	8	2	2	9
K	85.4	86.5	87.2	88.3	88.4	89.4	----	91.5	91.80	91.7	12826	1349	3008	1349	683	1986	----	1875	503	573	32	30	29	29	17	21	—	16	14	14.6	34	22	21	10	0	6	--	21	8	11
L	86.7	87.9	88.0	88.0	88.9	90.7	91.1	98.6	94.90	94.2	1091	1792	843	683	1798	1892	524	476	192	350	13	12	10	12	8	6	6	4	7	5.9	0	11	0	0	0	1	1	7	2	5
M	86.7	87.0	88.2	88.0	88.9	91.5	91.3	91.8	92.70	92.0	5165	2378	220	1008	1525	1798	1331	3964	1939	1077	28	18	10	9	10	11	8	21	11	8.5	45	16	0	0	0	0	5	50	10	2
N	84.6	84.4	86.6	86.9	87.7	89.8	89.6	89.9	90.50	90.5	1262	1005	448	925	1436	1176	1011	911	429	455	27	29	17	22	16	12	16	11	11	8.9	5	33	14	20	0	0	3	16	10	10
O	87.4	87.2	87.5	88.4	——	----	91.1	90.7	91.10	90.9	4069	1173	763	683	——	——	1305	1023	381	957	34	18	29	18	—	—	13	12	15	11.3	21	20	12	13	—	—	12	14	13	12
P	88.2	87.9	88.7	88.4	----	----	89.3	90.3	90.50	90.2	1349	2178	1176	603	----	----	1217	987	1193	1230	22	15	16	24	--	--	14	13	16	13.9	7	9	2	13	—	--	10	21	37	16
Q	87.7	89.0	89.4	90.6	89.6	90.6	90.9	90.9	90.40	91.0	3287	1005	146	925	1348	683	323	376	147	304	41	12	17	16	13	12	9	9	10	12.1	146	6	9	10	0	0	8	14	5	11
R	86.4	87.5	89.1	88.9	90.3	92.1	91.4	91.5	91.90	92.2	3697	3343	1608	2378	1436	448	683	824	503	870	39	30	19	18	17	10	12	11	11	11.6	10	21	5	10	0	0	14	14	3	9
S	87.1	87.7	87.8	90.0	90.0	90.7	91.3	91.9	93.60	93.1	2899	1522	2479	1176	3118	1615	1861	1401	661	1011	34	20	21	16	14	19	13	12	9	12.1	12	18	9	3	5	0	8	21	12	13
T	——	87.5	87.1	90.9	91.2	92.0	92.2	91.7	93.20	93.0	1262	2684	3008	1349	371	763	919	911	293	371	16	35	24	19	10	12	16	12	13	11.7	2	22	3	15	0	0	22	19	12	10
U	83.5	84.4	84.5	86.4	91.7	91.4	92.2	91.5	92.00	93.1	1436	2080	1986	1986	1798	2179	541	887	661	824	9	17	18	14	7	9	12	8	7	7.6	0	5	5	5	0	2	15	12	4	7
V	84.1	84.8	85.0	84.4	90.8	90.7	91.2	91.5	91.30	91.5	3230	1349	1436	763	295	603	796	595	263	716	14	16	20	17	6	6	10	5	7	6.7	3	0	0	5	0	0	7	9	2	2
W	86.8	89.8	87.3	88.5	90.7	90.1	90.4	91.7	90.80	91.5	3344	2378	603	2278	925	925	1274	864	355	589	8	13	14	8	5	7	7	7	8	7.7	3	9	0	3	0	0	10	11	2	2
X	84.5	85.4	89.6	88.3	90.9	91.2	90.0	90.2	90.90	90.0	2581	1349	146	1349	603	296	407	503	147	413	24	21	17	17	10	9	12	9	10	8.4	14	19	14	17	0	0	20	12	10	6
Y	87.2	86.6	87.1	90.7	91.5	91.0	90.1	91.9	94.20	93.1	5620	4592	925	295	3943	603	552	733	278	705	19	17	19	17	12	15	10	11	12	10.8	22	17	7	16	5	0	12	16	2	7
Average	85.6	86.4	87.1	87.9	89.9	91.0	90.9	91.6	92.00	91.9	3100	2211	1305	1350	1638	1116	961	1053	671	766	50	27	25	20	15	12	13	11	11	11.5	149	47	28	20	20	2	14	17	9	12.6

TABLE IV

SCREENING TESTS — COMPARISON OF GRAIN SIZE

Meshes to the inch	20	28	35	48	60	65	80	100	100
U.S. Series Equiv. No.	20	30	40	50	60	70	80	100	100

Carbohydrate Res. Div. No.	Percent retained on	Percent retained on	Percent retained on	Percent retained on	Percent retained on	Percent retained on	Percent retained on	Percent retained on	Percent passed through
3901	0.0	1.8	20.2	42.0	12.2	9.8	5.8	5.2	3.0
3902	0.0	1.2	28.6	39.2	12.4	7.8	5.0	3.8	2.0
3903	0.0	0.4	8.0	33.4	14.6	11.2	9.4	11.2	11.8
3904	0.0	0.2	24.0	51.2	10.2	6.2	3.8	2.6	1.8
3905	0.0	0.2	14.6	44.2	11.4	11.4	7.2	7.0	4.0
3906	0.0	0.4	16.4	46.4	13.2	8.8	5.8	5.4	3.6
3907	0.0	0.2	17.0	47.6	10.0	9.6	6.0	5.4	4.2
3908	0.2	1.6	19.8	44.2	12.8	8.6	5.2	4.8	2.8
3909	0.0	1.6	37.2	37.2	8.8	6.2	3.8	3.2	2.0
3910	0.2	0.4	16.4	51.2	12.2	8.6	5.0	3.4	2.6
3911	0.2	4.0	27.6	37.4	11.2	8.0	5.2	4.2	2.2
3912	0.0	1.6	50.0	30.8	7.4	4.8	3.0	1.8	0.6
3913	0.0	0.6	17.2	39.8	14.4	9.4	6.6	6.6	5.4
3914	0.0	0.6	18.8	34.4	13.4	9.8	8.2	9.0	5.8
3915	0.0	0.2	10.2	42.0	15.0	12.0	8.2	8.0	4.4
3916	0.0	0.4	27.6	45.8	9.6	7.4	4.0	3.4	1.8
3917	0.2	2.8	36.0	36.4	11.0	6.0	3.6	2.6	1.4
3918	0.0	0.0	13.4	49.0	11.6	10.6	6.4	6.0	3.0
3919	0.0	0.2	20.4	51.8	8.4	8.4	4.2	3.6	3.0
3920	0.0	0.6	32.4	33.4	10.2	8.6	5.8	5.8	3.2
3921	0.0	2.8	38.0	30.4	9.2	7.4	4.6	4.4	3.2
3922	0.2	1.2	22.2	34.2	12.6	10.6	7.0	6.6	5.4
3923	0.0	0.2	13.2	54.0	12.0	9.0	4.8	4.2	2.6
3924	0.2	1.0	20.0	35.2	10.4	11.0	8.2	8.4	5.6
3925	0.0	0.2	9.0	37.8	13.4	12.0	10.0	9.2	8.4
3926	0.0	0.2	20.4	47.4	14.4	7.0	5.0	3.6	2.0
3927	0.0	0.8	23.8	39.4	11.4	9.0	6.0	6.0	3.6
3928	0.2	4.8	25.4	35.0	14.0	8.0	6.2	4.4	2.0
3929	0.0	0.0	8.4	40.6	15.4	10.4	8.0	8.6	8.6
3930	0.0	0.0	15.8	39.2	12.8	11.0	7.8	7.6	5.8
3931	0.0	0.0	4.2	52.8	16.2	12.6	5.8	4.6	3.8
3932	0.0	0.4	24.4	52.8	7.6	6.4	3.6	2.6	2.2
3933	0.0	0.4	9.0	52.0	12.4	10.0	6.8	6.2	3.2
3934	0.0	0.0	9.4	43.8	13.2	9.0	8.6	7.6	8.4
3935	0.0	0.4	7.2	44.8	14.6	12.6	9.0	7.8	3.6
3936	0.2	1.6	30.2	37.4	9.0	8.2	5.2	5.2	3.0
3937	0.0	0.4	18.8	49.6	10.8	9.0	5.2	4.2	2.0
3938	0.0	1.0	15.2	43.2	14.4	11.0	6.0	5.6	3.6
3939	0.0	0.2	11.2	53.4	11.2	9.0	5.0	5.0	5.0
3940	0.0	0.2	4.4	40.8	14.8	11.6	8.2	9.2	10.8
3941	0.0	0.2	18.4	55.4	9.0	7.8	4.6	3.4	1.2
3942	0.0	0.2	16.8	48.8	11.0	9.4	6.0	5.2	2.6
3943	0.0	0.6	32.6	41.4	8.4	6.8	4.4	4.2	1.6
3944	0.0	0.4	24.4	42.4	11.8	8.2	5.4	5.6	1.8
3945	0.2	1.8	35.8	35.2	10.0	7.0	4.8	3.2	2.0
3946	0.2	5.6	41.4	32.4	8.4	4.6	3.2	2.6	1.6
3947	0.0	0.2	10.6	56.8	11.8	9.0	5.4	4.0	2.2
3948	0.0	0.2	12.2	46.2	11.2	11.0	7.2	7.0	5.0
3949	0.0	1.0	26.0	41.2	10.8	9.4	5.2	4.4	2.0
3950	0.0	0.2	7.0	55.2	12.0	8.8	6.4	6.0	4.4
3951	0.0	0.2	7.6	41.8	12.8	11.6	8.0	9.2	8.8
3952	1.0	2.0	4.6	48.4	12.4	14.2	6.8	6.6	4.0
3953	0.2	0.6	17.8	46.4	12.0	9.6	5.4	4.8	3.2
3954	0.0	0.4	34.6	42.4	9.0	6.4	3.0	2.4	1.8
3955	0.2	3.4	28.2	36.6	10.6	8.0	5.4	4.6	3.0
3956	0.0	1.0	15.6	46.2	15.6	9.0	8.0	2.0	2.6
3957	0.0	1.4	22.4	39.0	12.2	8.6	7.0	6.6	2.8
3958	0.0	0.2	11.6	45.0	13.4	9.8	7.2	7.2	5.6
3959	0.0	0.2	8.2	38.6	15.4	13.4	8.8	8.4	7.0
3960	0.0	0.6	18.0	43.6	11.2	9.6	6.8	5.8	4.4
3961	0.0	0.4	20.0	40.6	23.4	4.8	4.0	2.8	4.0
3962	0.2	0.4	8.6	55.2	13.4	9.2	5.6	4.4	3.0
3963	0.0	0.2	23.4	47.0	10.2	7.2	5.0	4.2	2.8
3964	0.0	0.6	12.0	41.2	14.8	12.4	7.0	6.8	5.2
3965	0.2	0.4	21.6	49.8	10.8	8.2	4.4	4.0	0.6
3966	0.6	4.6	34.8	38.4	9.2	6.0	3.6	2.4	0.4
3967	0.0	0.4	20.6	49.4	9.6	7.8	5.0	4.8	2.4
3968	0.0	0.2	10.8	53.4	14.0	10.0	6.2	3.8	1.6
3969	0.0	0.4	31.4	42.2	9.0	6.8	4.2	3.8	2.2
3970	0.0	0.2	13.2	47.2	11.4	11.0	6.6	6.2	4.2
3971	0.0	0.2	7.2	43.8	16.2	13.0	7.4	6.2	6.0
3972	0.2	0.6	41.2	41.6	4.4	4.0	3.4	3.0	1.6
3973	0.0	0.2	16.8	38.4	10.0	10.0	7.4	8.6	8.6
3974	0.0	0.2	12.6	54.6	13.0	9.6	5.0	3.4	1.6
3975 *	0.4	2.2	22.2	44.0	12.8	7.8	4.6	3.0	3.0
Averages	0.06	0.87	19.65	43.61	11.73	9.06	5.90	5.26	3.69

* Special Sugar not included in the averages.

5/6/40-vrt

TABLE V -- NON-STEFFENS FACTORIES
FORMULA RATINGS OF THE SUGARS AND ADDITIONAL OPERATING DATA

Carbohydrate Div. Number	White Sugar: Ash, % x 10^3	White Sugar: B-K Color Index	White Sugar: Total SO_2, % x 10^3	White Sugar: B-K Turbidity Index	White Sugar: Formula Rating	Predefecation: CaO on basis %	Predefecation: Cycles Minutes	White Massecuite: Washed Apparent Purity	High Apparent Purity	Low Raw Sugar: Apparent Purity	Low Raw Sugar: Where returned to Process	1st Liquor: Filtration Brix	1st Liquor: Temp. °C.	Filter Aid Data: Pounds per ton beets	Filter Aid Data: Stage in the Process Added	Carbon Data: Pounds per bag sugar	Carbon Data: Stage in the Process Added
3901	5.8	6.0	0.3	11.3	76.6	--	--	93.8	94.8	92.4	High Green to High Raw Pan	60.8	.96	.53	High raw melter	.09	High raw melter
3902	12.0	15.0	1.4	35.0	36.6	—	—	91.6	92.0	94.1	2nd Carbonation	55.9	95	.50	Thick juice	--	
3904	8.4	3.3	1.9	8.2	78.2	—	—	90.0	91.0	85.6	1st "	68.4	92	.32	Standard sirup blow-ups	—	
3907	6.2	1.9	1.2	9.1	81.6	—	—	90.9	88.9	88.0	1st "	72.7	90	.22	High wash and thick juice	—	
3908	8.9	3.7	1.7	9.0	76.7	—	—	90.5	89.1	89.1	Blow-ups	72.0	90	.16	Blow-up station	--	
3909	10.8	6.1	1.5	13.0	68.6	—	—	89.3	86.4	94.4	2nd Carbonation	58.7	95	.50	No data given	—	
3913	10.5	12.9	0.3	16.8	60.5	—	—	92.0	91.5	89.3	1st "	67.4	92	.616	Before 3rd presses - Standard Liquor	.36	Low raw melter
3914	8.8	9.6	0.5	3.1	78.0	0.2	Cont.	91.8	92.1	86.7	1st "	70.1	96	.55	Third presses	.30	Low raw melter
3916	12.7	8.2	2.2	24.9	52.0	—	—	87.5	83.5	95.0	Thick juice	62.6	95	.16	Thick juice presses	—	
3917	9.3	5.4	0.4	9.8	75.1	—	—	91.8	90.2	97.0	Melted in thick juice and boiled to High Raw	—	95	.40	Thick juice filtration	.16	In suction of evaporator supply pump
3921	17.3	9.2	0.4	17.7	55.4	—	—	88.8	84.6	97.5	Standard liquor	64.2	95	.49	Standard liquor presses	—	
3922	10.7	4.1	0.8	13.5	70.9	—	—	91.4	90.0	91.7	1st Carbonation	65.3	90	.43	Thick juice presses	.09	First press juice
3924	11.7	1.0	3.1	7.5	76.7	—	—	93.0	91.6	92.2	2nd Carbonation	71.8	99	.50	Standard liquor remelters	—	
3928	11.1	6.4	0.2	12.2	70.1	0.22	Cont.	92.7	91.8	91.2	Diffusion tanks	69.3	93	.535	Standard liquor	.15	Crystalliser and low melter
3931	13.0	8.1	0.6	29.3	49.0	0.30	Cont.	90.7	90.0	90.2	1st Carbonation	67.1	92	.93	Thick juice presses	.18	High melter and crystallisers
3936	9.0	2.5	0.6	6.7	81.2	0.22	ZnS_2O_4) --	91.9	92.9	91.1	2nd Carbonation	70.5	92	.50	Thick juice filtration	.23	2nd Carb. filtrate and removed before evaporation
3937	7.2	11.8	0.3	18.5	62.2	0.25	Cont.	90.3	86.5	98.1	2nd "	57.5	92	.38	Blow-ups	.10	Low raw melter
3941	20.0	6.7	4.8	19.5	49.0	—	—	90.9	86.9	89.0	2nd "	71.2	90	.47	First and second thick juice presses	.10	High sugar melter
3942	8.7	1.3	0.7	7.2	82.1	0.09	2.0	94.1	92.1	87.9	To high raw pan stock	68.6	93	.40	Filtra. of hi-raw melter & blow-up thick jce	.006	Low raw melter (occasionally)
3943	5.2	5.7	0.3	14.4	74.4	—	—	93.8	93.9	97.8	1st Carbonation	69.3	88.6	.24	High melter	—	
3948	13.2	2.0	2.9	14.6	67.3	—	—	94.0	92.4	92.8	1st Carbonation	64.9	95	.71	To standard liquor in high melter	.08	To thin juice after filtration and filtered out
3950	8.2	2.3	1.4	8.0	80.1	—	—	90.5	89.5	89.2	1st Carb. & High Raw Pans	69.9	88	.18	Thick juice standard sirup presses	—	
3952	14.8	4.1	1.9	16.2	63.0	—	—	90.5	90.3	90.0	2nd Carbonation	67.5	95	.51	Standard liquor filter presses	.11	High melter
3953	12.9	15.6	0.4	32.5	38.6	—	—	91.5	89.5	90.8	1st "	62.0	85	.53	Standard liquor filters	.15	Low melter
3955	10.5	7.2	0.3	17.6	64.4	0.25	2.0	92.1	92.5	93.1	Lime and juice mixer	61.0	88	.64	Blow-ups	.12	High raw melter
3960	10.3	1.5	1.6	6.5	80.1	—	—	91.8	89.2	86.7	1st Carbonation	70.7	87	.21	Blow-ups for thick juice filtration	—	
3961	13.9	6.5	2.1	22.5	55.0	—	—	90.2	87.5	91.4	2nd "	68.5	90	.61	First and second thick juice filtration	.11	Standard liquor melter
3964	7.6	8.0	0.9	15.7	67.8	0.25	15.0	93.1	92.9	92.8	1st "	70.9	85	.51	First liquor presses	.12	Thin juice boiler
3966	6.8	7.2	1.6	17.5	66.9	—	—	93.6	95.2	93.9	2nd "	69.2	88	.64	Thin juice and first liquor filters	.10	Before thin juice filters
3967	16.1	4.7	2.7	13.3	63.2	0.30	—	91.5	92.7	94.6	High wash at high melter	69.5	92	.467	Filter presses	.117	Low melter
3969	9.2	5.6	0.4	9.6	75.2	0.25	2.0	91.0	89.3	94.2	Blow-ups	65.8	92	.30	Standard liquor	.096	Blow-ups and high and low melters
3970	11.3	6.3	0.2	18.0	64.2	—	—	90.9	91.3	88.7	1st Carbonation	67.7	94	.57	Blow-up tanks	.066	Crystallisers
3972	10.3	6.2	0.5	9.4	73.6	0.345	Cont.	91.5	88.9	89.8	1st "	68.7	94	.56	Before 3rd presses (thick juice)	.07	Low raw melter
3973	11.9	4.1	1.8	15.3	66.9	—	—	92.1	90.0	91.5	High raw pans	71.4	98	.32	Thick juice presses	.07	Second carbonation
3974	5.4	3.4	2.0	10.5	78.7	—	—	93.9	92.2	91.3	1st Carbonation	70.0	92	.52	Blow-up before presses	.12	Low melter
Average	10.56	6.10	1.25	14.68	67.42			91.57	90.37	91.68				.459			

5/7/40-vrt

TABLE VI -- STEFFENS FACTORIES
FORMULA RATINGS OF THE SUGARS AND ADDITIONAL OPERATING DATA

Carbo-hydrate Div. Number	White Sugar: Asb. % x 10^3	White Sugar: B-K Color Index	White Sugar: Total SO_2 % x 10^3	White Sugar: B-K Turbidity Index	White Sugar: Formula Rating	Predefecation: CaO or equiv. Seccharate on beets %	Predefecation: Cycle Minutes	White Massecuite Apparent Purity	High Wash Apparent Purity	Low Raw Sugar: Apparent Purity	Low Raw Sugar: Where returned to Process	1st Liquor Filtration Brix	1st Liquor Temp. °C.	Filter Aid Data: Pounds per ton: beets	Filter Aid Data: Stage in the Process Added	Filter Aid Data: Pounds per bag: sugar	Carbon Data: Stage in the Process Added	Molasses worked on beets %
3903	10.8	4.6	1.1	13.6	69.9	--	--	93.1	91.1	94.3	Diffusion juice	59.4	92	.665	Before filter presses	.125	Low raw melter	6.2
3905	19.9	8.4	.7	18.6	52.4	.03	1.5	93.3	92.0	89.8	To high raw pans	68.6	97	.490	Blow-ups	.061	Sugar melter	9.26
3906	9.5	1.5	1.5	12.0	75.5	--	--	92.3	90.7	87.6	First carbonation	71.8	95	.500	Standard sirup at blow-ups	--		6.59
3910	7.9	12.3	.4	20.8	58.6	--	--	89.1	89.6	93.4	Thick juice at melter	56.3	90	.967	Bigh melter and thin jce.sulfur sta.	.037	Thin juice sulfur station	5.41
3911	17.2	13.9	.3	16.0	52.6	5.2	Cont.	91.0	88.4	94.5	Second carbonation	61.2	95	.600	Sulfur station and thick jce.filters	--		7.23
3912	7.6	11.8	.2	27.5	52.9	--	--	92.1	90.0	98.1	Beet end	59.8	99	.532	Blow-ups	.00008	Low melter	5.52
3915	10.8	12.6	.2	21.7	54.7	--	--	92.0	90.2	95.6	Second carbonation	65.4	92	.640	Thick juice presses	.16	Second carbonation	9.33
3918	5.9	7.0	.5	10.0	76.6	.10	Normal lag	92.1	89.9	93.1	" "	68.8	97	.740	1st and 2nd thick juice presses	.09	Thick juice melters before 1st filters	3.05
3919	7.7	6.6	.2	11.5	74.0	.10	" "	91.5	89.8	93.1	Melted in evap.thick juice	71.4	96	.650	" " " " " "	.12	" " " " " "	8.35
3920	12.6	4.5	.7	10.0	72.2	.15 (Na_2CO_3)		91.3	92.5	95.8	To high raw pan	69.6	95	.500	Blow-ups	--		8.43
3923	11.6	7.8	.5	16.5	63.6	--	--	92.2	90.8	92.8	Ahead of 1st thick jce.filters	67.0	93	.230	Ahead of 1st thick jce.filtration	.019	Combined melters	5.75
3925	14.6	4.9	.3	11.2	69.0	--	--	91.7	89.4	91.1	Carbonation tanks	68.3	98	.502	Standard liquor	.120	Low raw melters	7.11
3926	11.8	5.3	1.0	13.2	68.7	--	--	90.7	88.2	84.7	Bigh raw pan	72.1	90	.450	Blow-up thick juice	--		5.91
3927	12.1	9.4	.9	18.9	58.7	--	--	93.1	91.6	93.7	Sulfur station measuring tank	67.1	97	.680	Before filters	--		6.54
3929	14.7	4.4	1.8	12.0	67.1	.15	1.0	91.7	88.5	89.5	2nd carbonation	63.1	91	.490	Thick juice	--		5.35
3930	5.9	3.9	.4	7.0	82.8	--	--	94.2	94.9	95.3	Intermediate pan	71.6	65	.530	Thick juice	.12	High raw melter	6.82
3932	7.4	9.6	.7	10.7	71.6	--	--	92.7	87.9	93.8	2/3 1st Carb. & 1/3 blow-up	66.9	95	.570	Blow-ups	.10	After 2nd carb. filters	10.23
3933	20.0	8.4	2.2	19.9	49.5	--	--	93.2	92.6	93.0	First carbonation	71.3	87	.320	1st liquor filters	.08	Low melter	7.61
3934	13.0	9.7	1.5	23.5	47.3	--	--	91.8	89.5	93.8	Second carbonation	72.3	84	.370	In blow-up thick juice	.003	Used to finish sugar end in melters	6.15
3935	23.3	8.3	.4	11.5	56.5	--	--	89.4	87.1	95.9	Blow-up and high raw pan	66.6	86	.500	High melter	.13	Before second carbonation	8.3
3938	7.8	14.2	.2	19.0	58.8	--	--	92.7	92.4	97.1	Second carbonation	61.9	98	.843	Thick juice	.204	Thin juice	6.62
3939	6.7	4.9	.4	13.8	74.2	--	--	91.5	92.2	91.1	First carbonation	70.0	90	.17	First liquor before filtration	.15	Second presses after sulphitation	9.05
3940	10.0	21.5	1.4	37.1	30.0	--	--	90.1	89.1	90.5	First carbonation	63.3	90	.90	Standard liquor filters	.07	Crystallizers and high melters	5.70
3944	9.8	5.9	.3	14.1	69.9	No data	Cont.	92.6	89.8	97.9	Second carbonation	67.0	96	.46	Blow-up thick juice	.19	At low melter	5.92
3945	8.5	7.1	.5	10.7	73.2	.2	2.0	91.9	90.7	97.6	Blow-ups	64.2	100	.74	Thick juice presses	.95	No. 3 body of the evaporators	5.32
3946	14.0	6.8	.8	13.9	64.5	--	--	90.37	87.12	93.71	First carbonation	63.4	92	1.222	Thick jce.green and wash filters	--		4.48
3947	13.0	14.8	1.1	26.6	44.5	--	--	91.70	91.6	94.0	First carbonation	68.1	85	.44	First liquor filtration	.21	Low melter	6.51
3949	8.5	7.4	..2	20.0	63.9	--	--	92.0	91.8	94.0	With hi-green to hi-raw pan	70.7	90	.53	Thick juice filtration	.12	High raw melter	6.19
3951	10.4	7.5	.2	15.5	66.4	--	--	92.3	91.0	92.3	Diffusion measuring tanks	65.0	92	.71	Standard liquor	--		6.69
3954	6.8	7.7	.2	12.0	73.3	--	--	93.2	87.2	95.5	First carbonation	67.0	97	.50	Blow-ups	--		7.59
3956	13.8	11.0	.4	11.7	63.1	.50	Cont.	91.7	89.6	94.3	High raw pan	59.5	90	1.01	Thick juice filters	.67	Second carbonation or thin juice	7.83
3957	14.8	3.5	.9	10.0	70.8	--	--	91.1	88.6	90.3	First carbonation	71.4	85	.48	Thick juice or standard liquor	--		5.37
3958	12.4	19.6	1.0	32.5	34.5	--	--	91.7	89.6	91.5	First carbonation	70.8	87	1.04	Thin and thick juice	.10	After 2nd carb. filtration	7.00
3959	11.1	12.3	.2	23.1	53.3	--	--	90.6	90.3	98.0	Second carbonation	66.0	92	.446	Blow-up filtration	.159	Low raw melter	7.36
3962	13.0	1.8	1.4	9.9	73.9	--	--	90.2	87.1	86.9	First carbonation	69.6	89	.52	In blow-up thick juice presses	--		6.43
3963	14.2	6.3	1.4	19.6	58.5	--	--	92.4	90.5	92.5	Second carbonation	66.2	94	.48	Thin and thick juice filters	.01	Steffan house foam breaker	5.95
3965	6.9	8.1	Trace	9.5	75.5	--	--	93.1	86.3	97.3	Standard sirup	66.2	93.4	.211	Standard sirup filters	--		6.58
3968	12.1	2.2	1.3	6.1	78.3	--	--	91.0	89.9	86.8	1st Carb.or hi-raw pan	67.7	90	.75	Thick juice filtration	.10	Blow-up thick	4.66
3971	11.1	9.0	1.5	19.4	59.0	--	--	94.0	93.2	94.9	1st or 2nd carbonation	67.7	88	1.01	Standard liquor filtration	.12	Standard liquor	5.01
Averages	11.51	8.37	.76	16.29	63.07			91.86	90.06	93.21				.599				6.70

TABLE VII

COMPARISON OF REFLECTANCES OF BEET SUGARS FROM THE SAME FACTORIES

Carbohydrate Res. Div. No.	1939	1938	1937	1936	1935	1934
3901	89.6	91.4	92.4	89.5	----	----
3902	90.2	90.4	91.6	91.2	----	----
3903	92.3	94.3	93.7	92.4	92.4	92.1
3904	90.6	91.4	92.9	92.0	91.2	91.6
3905	91.4	91.8	93.6	91.2	91.4	91.4
3906	91.5	92.8	92.8	92.4	91.2	90.8
3907	91.7	91.9	92.9	----	----	----
3908	91.3	91.4	92.0	90.5	90.5	90.5
3909	90.4	89.5	91.3	89.1	88.3	88.8
3910	89.9	89.8	92.6	91.3	90.3	89.8
3911	89.3	90.2	----	90.4	88.8	86.8
3912	89.3	90.3	90.4	90.6	88.5	91.8
3913	91.6	91.8	92.2	89.4	89.3	88.3
3914	92.5	93.8	92.6	90.8	89.2	90.6
3915	91.7	91.4	91.8	91.2	89.5	89.3
3916	90.7	90.2	90.2	90.3	90.7	89.4
3917	91.3	91.3	90.9	----	----	----
3918	91.9	92.2	----	----	----	----
3919	92.5	91.3	92.4	90.6	89.2	90.6
3920	92.0	91.5	90.3	90.0	----	----
3921	88.9	90.5	90.3	88.6	88.7	89.8
3922	91.4	90.8	92.4	91.2	89.8	89.9
3923	92.4	91.9	92.6	91.5	90.5	89.4
3924	93.0	93.6	92.4	91.8	91.9	91.1
3925	92.3	91.7	93.4	----	----	----
3926	90.2	91.8	91.9	92.3	91.8	91.1
3927	90.4	92.9	93.1	91.2	91.7	90.4
3928	90.8	91.4	----	----	----	----
3929	92.7	94.2	93.6	93.0	91.6	89.8
3930	91.6	92.4	93.1	90.6	89.9	87.9
3931	90.5	90.8	90.5	86.7	89.7	89.3
3932	92.0	92.0	93.2	90.5	91.2	91.2
3933	91.1	92.3	92.6	91.6	91.6	91.2
3934	91.1	91.2	92.9	91.4	91.1	90.1
3935	91.5	91.4	91.8	90.8	89.6	90.0
3936	92.4	91.5	90.7	90.2	88.9	88.9
3937	90.3	89.7	90.7	90.8	88.8	90.3
3938	88.6	88.6	90.3	89.8	89.2	89.0
3939	92.1	91.9	93.0	92.2	93.5	91.7
3940	92.5	94.0	93.7	91.4	----	----
3941	93.2	93.3	93.2	92.5	92.4	----
3942	93.5	92.3	93.1	----	----	----
3943	90.6	90.8	92.2	90.5	90.3	90.0
3944	90.4	89.0	90.3	90.6	90.8	89.4
3945	90.8	91.0	92.4	89.6	90.5	90.3
3946	91.0	90.7	90.5	89.8	90.6	90.6
3947	92.3	90.6	92.2	91.9	90.4	91.2
3948	93.4	94.2	93.4	91.6	91.1	91.4
3949	91.7	91.5	91.7	89.5	90.0	89.2
3950	91.9	92.5	93.1	92.1	91.3	91.3
3951	92.5	92.0	93.2	92.5	----	----
3952	92.8	92.6	94.0	91.5	----	----
3953	90.6	91.9	92.2	90.9	89.8	----
3954	91.6	90.6	92.6	91.4	90.0	89.3
3955	91.2	90.8	90.9	----	----	----
3956	91.3	90.6	91.9	91.9	90.3	90.1
3957	92.6	90.7	91.8	88.5	92.0	91.1
3958	94.0	94.3	94.2	93.7	91.2	89.2
3959	90.1	89.4	91.3	90.2	88.5	89.9
3960	91.7	92.5	92.7	92.2	91.6	92.2
3961	91.5	91.7	93.6	92.3	----	----
3962	93.2	93.7	92.9	92.6	91.1	91.3
3963	91.7	92.3	----	----	----	----
3964	92.7	92.3	92.8	92.4	90.8	91.7
3965	90.8	91.2	91.3	----	----	----
3966	91.3	91.4	91.4	90.5	90.3	----
3967	91.3	91.2	91.4	90.9	90.9	90.8
3968	93.4	92.6	93.7	93.2	92.5	91.3
3969	92.0	91.8	92.2	92.2	90.6	90.0
3970	92.5	93.4	93.0	89.4	----	----
3971	93.4	93.9	----	----	----	----
3972	92.0	93.0	92.8	89.7	----	----
3973	91.7	91.8	----	----	----	----
3974	91.5	92.9	92.7	----	----	----
3975 *	91.5	93.8	93.9	93.5	93.1	90.6
Averages	91.54	91.72	92.27	91.05	90.44	90.27

* Special Sugar not included in averages.

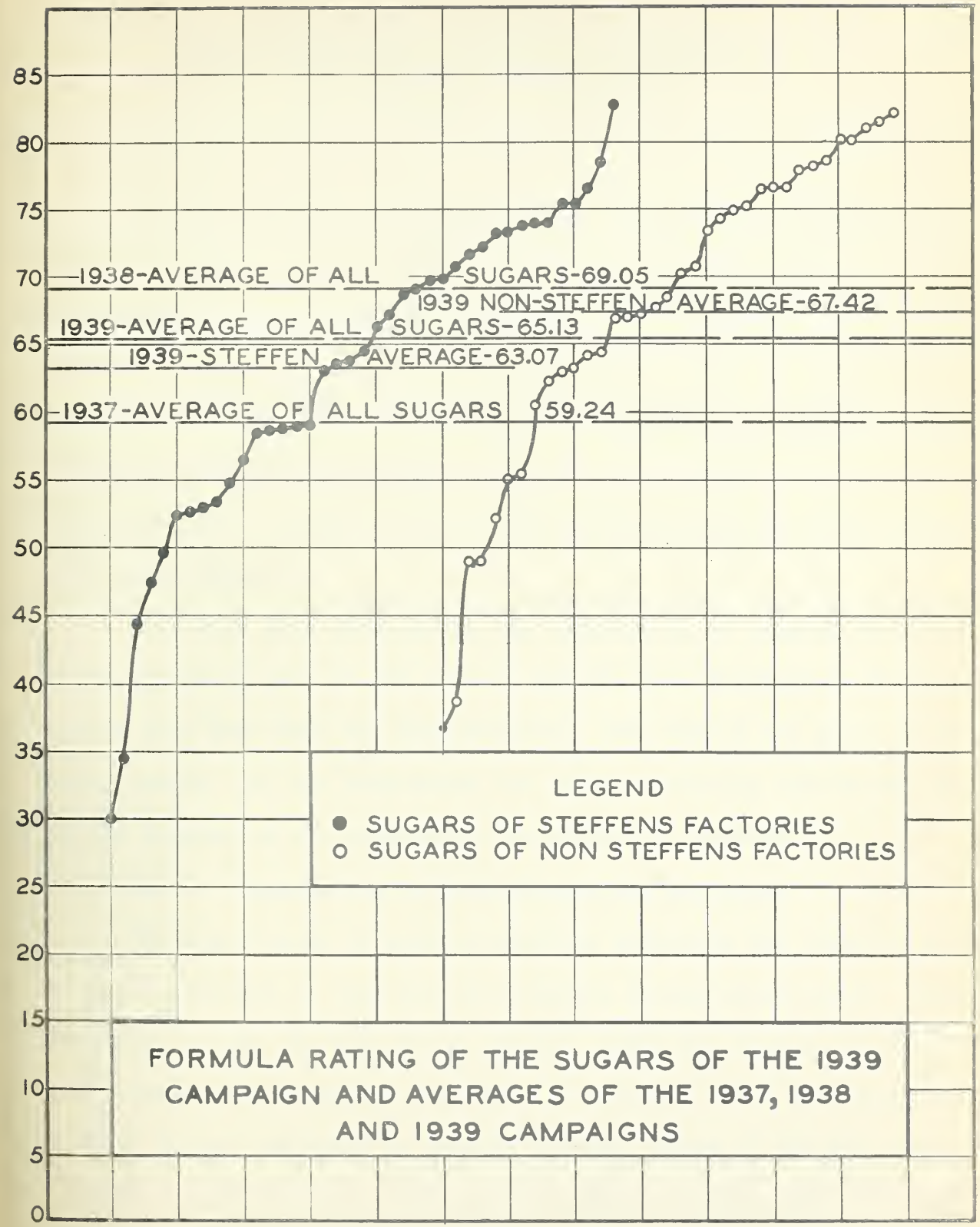
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
1938-AVERAGE OF ALL SUGARS-69.05
1939 NON-STEFFEN AVERAGE-67.42
1939-AVERAGE OF ALL SUGARS-65.13
1939-STEFFEN AVERAGE-63.07
1937-AVERAGE OF ALL SUGARS 59.24
LEGEND
SUGARS OF STEFFENS FACTORIES
SUGARS OF NON STEFFENS FACTORIES
FORMULA RATING OF THE SUGARS OF THE 1939 CAMPAIGN AND AVERAGES OF THE 1937, 1938 AND 1939 CAMPAIGNS

PLATE I

II. REPORT ON BIOLOGICAL STUDIES OF SUGARS

By H. H. Hall, Food Research Division
Bureau of Agricultural Chemistry and Engineering
U. S. Department of Agriculture.

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In this section of the report data are presented regarding the biological quality of the sugars. Examination of the samples was made to determine relative amounts of substances which stimulate the growth of yeasts in sugar solutions and which, therefore, help to determine the suitability of the sugar for use in the manufacture of beverages. The samples were likewise examined for various micro-organisms which influence the suitability of the sugar for use in canning, manufacture of beverages, and dairy products.

The data were obtained by the examination of samples described in the preceding part of the report, and the same Carbohydrate Division numbers have been used for identification. The results are given in two parts, namely, (1) the examination for yeast stimulating substances, and (2) the examination for thermophilic and mesophilic organisms.

Part 1. Examination for Yeast-Stimulating Substances

The significance of yeast-stimulating substances has received considerable attention by numerous investigators during recent years. Comprehensive reviews of this entire subject, under the heading of "Bios", were published in scientific journals, as follows: "The Bios Question" by F. W. Tanner, published in Chemical Reviews, volume 1, 397-472 (1924), and "Review of Bios" by W. L. Miller, published in the Journal of Chemical Education, volume 7, 257-267 (1930). Numerous other papers regarding "bios" have been published in several scientific journals since the later

review was written. The significance of these substances in white sugar was discussed in a previous report (Report on Biological Studies of Sugar, 1932) and in an article entitled "Yeast Growth Stimulants in White Sugars" by Hall, James and Stuart, published in Ind. Eng. Chem., volume 25, 1052 (1933), in which a practical laboratory method was given for the determination of yeast stimulants in sugar. The location of stimulating substances with respect to the surface of sugar crystals was determined and reported in an article "Crystal Surface Contaminants and Biological Quality of Sugar" by Hall and James, published in Facts About Sugar, June, 1936. Briefly, it was found that these substances are located at or near the crystal surface, and that elimination is facilitated by the complete removal of mother liquors from the white sugar.

Various samples of sugar, taken from different factories and representing variations in methods of purification, were studied. In testing these samples, the amounts of yeast growth obtained in 10 percent solutions of the sugars were used as a basis for classifying the sugars on what might be termed their "biological quality."

During the past campaign the same procedure was followed as described in the report issued in 1932 and in the article by Hall, James and Stuart. Seventy-five samples of white sugar, collected by the Carbohydrate Research Division, were thus classified.

The number of yeast cells placed in each test sugar solution (i.e. the "inoculum") is rated as one unit, and the number of cells developing on incubation in any one sample is considered a multiple of the number of cells in the inoculum. This total yeast growth is termed the yeast crop. The samples are ranked in ascending order of their yeast inoculum multiples,

and are identified by their Carbohydrate Research Division numbers. The results are given in Table I, page 13.

The results of the examination show that the average amount of yeast stimulating substance is slightly larger in the samples this year than in the campaign years 1937 and 1938. The average yeast inoculum multiples for all the samples during the past five years are as follows:

Year	Yeast Inoculum Multiple
1939	9.1
1938	7.6
1937	8.0
1936	8.6
1935	12.4

Again, this year, there is a slight correlation between the amount of yeast stimulating substance and the ash content of the sugars. The average ash content of the sugars having multiples less than 10.0 is 0.0104 percent, as compared with 0.0117 percent for those having multiples greater than 10.0. These are almost duplicate values of those obtained for the samples last year, which were 0.0106 and 0.0116 respectively, indicating a difference in the biological quality of the samples during the past two years which is not correlated with the ash content of the sugars.

TABLE I

Ranking of Sugar Samples Collected During 1939 Campaign.

Carbohydrate Division Number	Rank	Yeast Inoculum Multiple	Carbohydrate Division Number	Rank	Yeast Inoculum Multiple
3968	1	1.9	3901	43	8.7
3975	2	2.4	3922	44	9.0
3932	3	2.5	3928	45	9.0
3949	4	2.9	3955	46	9.3
3939	5	3.0	3943	47	9.4
3962	6	3.7	3959	48	9.4
3974	7	3.7	3906	49	10.0
3934	8	4.3	3972	50	10.0
3944	9	4.3	3917	51	10.2
3969	10	4.4	3940	52	10.3
3919	11	4.7	3920	53	10.4
3924	12	4.9	3971	54	10.4
3950	13	4.9	3953	55	10.9
3927	14	5.0	3908	56	11.1
3933	15	5.1	3915	57	11.3
3957	16	5.2	3941	58	11.3
3918	17	5.4	3958	59	11.7
3923	18	5.4	3929	60	12.0
3945	19	5.4	3904	61	12.4
3954	20	5.6	3937	62	12.6
3909	21	6.2	3938	63	12.7
3946	22	6.2	3931	64	13.2
3911	23	6.4	3952	65	13.3
3907	24	6.6	3960	66	13.3
3925	25	6.6	3914	67	13.7
3902	26	6.8	3964	68	14.3
3942	27	6.8	3947	69	14.5
3948	28	6.8	3963	70	14.5
3926	29	7.0	3935	71	15.2
3951	30	7.0	3910	72	17.5
3956	31	7.0	3916	73	23.0
3965	32	7.0	3913	74	24.3
3936	33	7.1	3967	75	40.2
3966	34	7.1			
3970	35	7.1			
3903	36	7.3			
3921	37	7.5			
3930	38	8.1			
3905	39	8.5			
3912	40	8.5			
3961	41	8.5			
3923	42	8.6			

Part 2. Bacteriological Examination

The scope of the bacteriological work has been expanded, and this year for the first time the samples have been examined to determine their bacterial flora which would affect the use of sugar in beverages, dairy products, frozen desserts, etc. The usual examination was made of the samples for thermophilic bacteria, in order to determine their suitability for canning purposes. Considerable concern has recently been shown by food manufacturers other than canners in the mesophilic group of sugar-borne organisms, a group of organisms which includes yeasts, molds and bacteria that grow at ordinary temperatures. The significance of yeast and molds in most food products is well known, in that they usually cause fermentation or mustiness and an unsightly product, respectively.

The effects caused by bacteria depend largely upon the characteristics of the bacteria and the composition and character of the product in which they are grown. They produce acid conditions, off-flavors and odors, and frequently change the physical properties of products. Although much effort has been spent in preventing the entrance of organisms of this group into food products, uniform standards have not been established for this group of organisms. However, some industries (e.g., dairy products manufacture, particularly production of sweetened condensed milk) have tentatively adopted bacterial standards with which the sugar must comply.

The American Public Health Association has been devising standard methods for the bacteriological examination of ingredients used in frozen desserts and related products. At the request of this Association a uniform method of testing sugar for mesophilic type ("The Microbiological Examination of Sweetening Agents") has been submitted by the writer. Samples are examined

by this method for "total aerobic" bacteria, "acid-producing" bacteria, yeasts and molds. Essentially the method is as follows: Twenty grams of sugar are weighed into a sterile 150 ml. flask marked to 100 ml. Sterile water is added to the mark and the flask is rotated until the sugar is dissolved. Duplicate one and five ml. portions are transferred to petri plates. One set of plates is poured with brom-cresol-purple dextrose tryptone agar for the detection and enumeration of total and acid type bacteria. The second set of plates is poured with wort agar for the detection and enumeration of yeasts and molds. All plates are incubated at 30° C. for 72 hours. The results of the examination for mesophilic organisms are given in Table II, pages 18 - 20.

The examination of the samples for thermophilic bacteria was made according to methods recommended by the National Canners Association laboratory. The examination was for "total aerobic" bacteria, "flat sour", "hard swell" and "hydrogen sulfide" types. References to various publications regarding the presence and significance of these types of microorganisms occurring in sugar have been given in previous reports. Several of these are repeated for the benefit of those who have recently undertaken bacteriological testing.

Cameron, E. J. and C. C. Williams. (1938) The Thermophilic Flora of Sugar in its Relation to Canning. Jr. Bacteriology, Vol. 15, page 31; Cameron, E. J. and J. Yesair. (1931) Sugar Contamination; Its Effect in Canning Corn. The Canner, Vol. 72; Owen, W. L. and R. Mobley. (1932) Thermophilic Bacteria in Refined Cane Sugars. Ind. Eng. Chem., Vol. 24, page 104; Calton, C. F. (1936) Thermophilic Contamination Within the

Sugar Factory. Ind. Eng. Chem., Vol. 28, page 1235; Cameron, E. J. (1938) Report on Methods For Detecting and Estimating Numbers of Thermophilic Bacteria in Sugar. Jr. Assoc. Official Agricultural Chemists, Vol. 21, No.3, page 457, August.

Attention is again called to the fact that, in order to be acceptable for use in canning, sugars must conform to certain bacteriological standards, which limit the number of bacterial spores permitted. The maximum numbers of bacterial spores permitted by the National Canners Association, based on the examination of five samples from a single lot of sugar, are as follows:

Total Aerobic Thermophilic Spores:

"For the five samples examined, there shall be a maximum of not more than 150 spores and an average of not more than 125 spores per 10 grams of sugar."

Aerobic Flat Sour Spores:

"For the five samples examined, there shall be a maximum of not more than 75 spores and an average of not more than 50 spores per 10 grams of sugar."

Anaerobic Sulfide Spoilage Spores:

"These shall be present in not more than two (40 percent) of the five samples and in any one sample to the extent of not more than five spores per 10 grams."

Anaerobic Thermophilic Hard Swell Spores:

"These shall be present in not more than three (60 percent) of the five samples and in any one sample to the extent of not more than four (65+ percent) tubes (method for testing)."

The suitability of the campaign composite samples of sugar for canning purposes is based on the minimum numbers of spores of any type permitted

for five samples as shown by the above standards. For the purpose of this report the results from the campaign composite sample are considered equivalent to the average of the data obtained from five individual samples. The data obtained are shown in Table II, pages 18 - 20.

TABLE II

Bacteriological Examination of 1939 Sugars.

Carbohydrate Division Number	Thermophilic Bacteria: Aerobes: Total count per 10 g.	Thermophilic Bacteria: Aerobes: Flat sour per 10 g.	Thermophilic Bacteria: Anaerobes: Sulfide per 10 g.	Thermophilic Bacteria: Anaerobes: Hard Swell % tubes with growth	Mesophilic Organisms: Aerobic Bacteria: Total per 1.0 g.	Mesophilic Organisms: Aerobic Bacteria: Acid per 1.0 g.	Mesophilic Organisms: Yeast: Total per 1.0 g.	Mesophilic Organisms: Molds: Number colonies per 1.0 g.
3901	80	50	0	0	51	17	0	1
3902	100	85	0	100	22	7	0	2
3903	10	10	0	0	25	10	0	0
3904	0	0	0	0	30	8	0	1
3905	60	50	0	0	12	9	0	1
3906	0	0	0	0	36	25	0	1
3907	50	30	0	0	15	5	0	0
3908	10	10	0	0	28	8	0	0
3909	125	105	0	33	44	8	0	1
3910	60	45	3	17	65	25	0	1
3911	515	460	0	0	260	130	0	3
3912	10	10	0	0	3	1	0	0
3913	30	30	0	0	35	20	0	1
3914	0	0	0	0	13	2	0	1
3915	20	20	0	0	190	100	0	0
3916	210	180	0	0	60	55	0	0
3917	10	10	0	0	395	45	0	2
3918	0	0	0	0	45	35	0	0
3919	80	50	0	0	90	30	1	1
3920	5	5	0	100	120	80	0	1
3921	280	230	0	100	100	50	0	0
3922	10	10	0	0	39	5	0	1
3923	30	25	0	0	110	10	0	1
3924	0	0	0	0	5	3	0	0
3925	20	20	0	17	31	12	0	1
3926	0	0	0	0	12	10	0	1
3927	0	0	0	0	110	30	0	1
3928	5	5	0	17	14	4	0	0

TABLE II (Cont'd)

Bacteriological Examination of 1939 Sugars.

Carbohydrate Division Number	Thermophilic Bacteria: Aerobes: Total count per 10 g.	Thermophilic Bacteria: Aerobes: Flat sour per 10 g.	Thermophilic Bacteria: Anaerobes: Sulfide per 10 g.	Thermophilic Bacteria: Anaerobes: Hard Swell % tubes with growth	Mesophilic Organisms: Aerobic Bacteria: Total per 1.0 g.	Mesophilic Organisms: Aerobic Bacteria: Acid per 1.0 g.	Mesophilic Organisms: Yeast: Total per 1.0 g.	Mesophilic Organisms: Molds: Number colonies per 1.0 g.
3929	10	0	0	0	44	36	0	0
3930	0	0	0	0	8	8	0	0
3931	5	5	0	0	160	125	0	20
3932	5	5	0	0	25	25	0	0
3933	10	10	0	33	40	20	0	1
3934	15	10	0	0	45	30	0	1
3935	730	730	0	0	275	245	1	0
3936	5	5	0	0	95	90	0	0
3937	300	240	0	0	115	105	0	1
3938	200	150	0	0	14	6	0	0
3939	5	5	0	0	125	30	0	16
3940	10	10	0	0	75	35	0	0
3941	0	0	0	0	70	40	5	0
3942	15	10	0	0	9	7	0	0
3943	0	0	0	0	7	2	1	0
3944	30	30	0	0	22	15	0	0
3945	15	15	0	0	6	4	0	0
3946	50	50	0	17	90	80	0	0
3947	5	0	3	0	130	55	2	2
3948	15	15	0	0	47	38	0	2
3949	55	45	0	50	45	25	0	3
3950	0	0	0	0	13	13	0	0
3951	40	40	0	0	16	7	1	1
3952	0	0	0	0	39	21	0	0
3953	10	10	0	0	200	190	0	6
3954	0	0	0	0	28	19	0	0
3955	160	140	3	0	130	10	0	1
3956	0	0	0	0	41	12	0	0

TABLE II (Cont'd)

Bacteriological Examination of 1939 Sugars.

Carbohydrate Division Number	Thermophilic Bacteria: Aerobes: Total count per 10 g.	Thermophilic Bacteria: Aerobes: Flat sour per 10 g.	Thermophilic Bacteria: Anaerobes: Sulfide per 10 g.	Thermophilic Bacteria: Anaerobes: Hard Swell % tubes with growth	Mesophilic Organisms: Aerobic Bacteria: Total per 1.0 g.	Mesophilic Organisms: Aerobic Bacteria: Acid per 1.0 g.	Mesophilic Organisms: Yeast: Total per 1.0 g.	Mesophilic Organisms: Molds: Number colonies per 1.0 g.
3957	0	0	0	0	29	13	0	0
3958	0	0	0	0	85	8	0	0
3959	10	10	0	17	51	14	0	0
3960	0	0	0	0	16	13	0	0
3961	0	0	0	0	105	40	0	2
3962	0	0	0	0	22	20	0	0
3963	10	10	0	0	185	60	1	2
3964	5	5	0	0	2	0	0	0
3965	5	5	0	0	5	3	0	0
3966	10	5	0	0	15	15	0	5
3967	0	0	3	17	30	10	0	0
3968	0	0	0	17	40	30	0	0
3969	55	35	0	0	125	20	0	0
3970	0	0	0	0	80	80	1	3
3971	10	0	0	0	3	3	0	1
3972	40	40	0	0	40	25	0	0
3973	5	0	3	0	65	30	0	1
3974	5	5	0	0	30	10	0	1
3975	35	35	0	33	35	15	0	0

Ten samples, or 13.3 percent, contained spores in excess of the numbers permitted by the standards. All but one of the substandard samples (3920) contained excessive aerobic spores. This is the first year since the 1935 campaign that there has not been an improvement in the bacteriological quality of the samples. The following data show the number and percent of samples tested and passed during the past five years.

Year	No. samples tested	No. samples passed	Percent samples passed
1939	75	65	86.7
1938	77	74	96.1
1937	70	65	92.9
1936	70	59	83.6
1935	65	47	72.4

Although the results show that 13.3 percent of the campaign composite samples did not meet the canning grade specifications, this does not necessarily mean that all strikes of sugar produced by those factories were excessively contaminated, or that none were suitable for canning purposes. This is especially true when the bacteria counts border on, and slightly exceed, the standards. It is evident in these cases that a number of low count strikes were included in the composite. Conversely, the fact that a composite just meets the standard does not necessarily imply that all strikes represented in the composite were within the standards and were acceptable as canning grade sugar. The conditions pointed out further illustrate the need for careful bacteriological control in connection with processing and marketing.

Summary.

The data indicate that the average quality of the sugars from the 1939 campaign is not quite as high as that for the 1938 campaign. This is indicated by some of the data presented in Part I of the report and

perhaps more strongly by all of the data in Part II. It is difficult to determine the exact extent of the change in quality since a multiplicity of factors are involved.

The chemical data show that improvement was made in certain factors of sugar quality through the more complete elimination of some impurities, although increased amounts of other impurities were found as compared with the 1938 sugars. No improvement was shown in the average biological quality of the 1939 campaign sugars, as compared with the 1938 sugars.

In considering over-all quality changes it is necessary to recognize especially the factors which influence both the chemical and the biological quality of sugars. Perhaps the most significant quality factor in Part I which is related to the findings in Part II of this report is the B-K turbidity index. Turbidity in sugar may result from the failure to completely remove non-sugar solids, including bacteria, yeast growth-promoting substances, etc., during filtration. The B-K turbidity index is a factor in the sugar rating formula and is related to other factors (e.g., yeast inoculum multiple and percentage of sugars passing the N. C. A. bacterial standards) which are not included in the sugar rating formula but which have a considerable effect in determining quality. The correlation between the B-K turbidity index and these factors is illustrated in the following tabulated data, which include average results for the past two campaigns.

	Campaign Year	
	1939	1938
Average sugar rating from formula	65.13	69.05
B-K turbidity index	15.60	11.40
B-K color index	7.2	7.5
Ash percent	.0110	.0109
Sulphites p.p.m.	9.59	11.50
Yeast inoculum multiple	9.1	7.6
Sugars passing N.C.A. bacterial standards (%)	86.7	96.1

It will be seen that the only quality factor in the foregoing tabulation showing any marked degree of improvement is the sulphite content of the sugars. This improvement is insufficient to overcome the difference in the average ratings for the years 1939 and 1938. The increase in the B-K turbidity index is the factor which was of greatest importance in the difference in quality, as determined by the rating formula, for the years 1939 and 1938.

The values for the yeast inoculum multiple and the percentage of sugars passing the N.C.A. bacteriological standards, which are given in Part II, bear a relationship to the values obtained by means of the rating formula, and appear, therefore, to be related to the findings in Part I of the report.